NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

# The Foundry Trade Journal. AND THE IRON AND STEEL RECORD.

Vol. 5, No. 26. FEBRUARY 18, 1904. Price SIXPENCE Net.

## CONTENTS:

| | PAGE |
|---|---|
| FOUNDRYMEN'S CONVENTION - - - | 39 |
| PORTRAITS OF PIONEERS— | |
| II.—JAMES BEAUMONT NEILSON - - | 46 |
| ALLOYS USED IN FOUNDRY PRACTICE.—II. - | 48 |
| DESCRIPTION OF MAYER'S PATENT BRASS AND COKE RECOVERING MILL - - - | 60 |
| THE PASSIVE STATE OF IRON - - - | 64 |

Correspondence. Queries. Among the Foundries. Scottish Notes. Notes. Metal Chart.

London:
THE FOUNDRY PUBLISHING CO., Ltd.,
104, Great Russell Street, W.C.

AGENTS:
BRADFORD: H. M. Trotter & Co., Albion Court, Kirkgate.
DARLINGTON: Walker & Wilson, 3, Park Lane.
HUDDERSFIELD: Charles H. Pickles, Pack Horse Yard.
GLASGOW: Wm. Holmes & Co., Ltd., 9, Mitchell Lane.
MIDDLESBROUGH: Joseph Parkin, 4, Bridge Street West

# SMOKE CONSUMERS.

## NO SMOKE! . .

## . . LESS FUEL!

You can burn anything with one of Gregory and Foster's Smoke Consumers, without any smoke.

FREE TRIALS GIVEN.

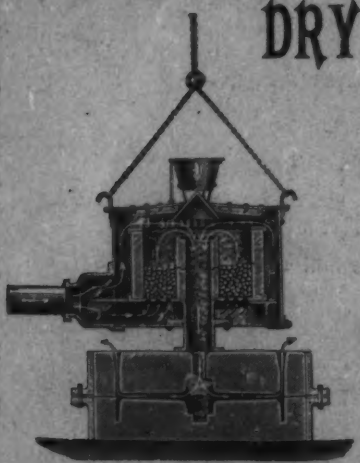
THE SMOKE PROBLEM SOLVED.

Adopted by His Majesty's Government at Woolwich, Enfield, and all the leading firms throughout the country.

## GREGORY and FOSTER,

***23, Brooksby Street, London, N.***

# DRY YOUR MOULDS ON THE FLOOR.



Our portable mould drier is a success. Great saving in time and handling of moulds. Economical in the use of fuel; from one to two hours' time being sufficient to dry the majority of moulds.

*BUILT IN FOUR SIZES.*
*WRITE FOR PRICES.*

## J. W. & C. J. PHILLIPS,

**23, College Hill, London, ENGLAND.**

39
slp

( Bind in in )

# THE FOUNDRY TRADE JOURNAL.

AND

## The IRON and STEEL RECORD.

**Vol. 5.** **FEBRUARY 18, 1904.** **No. 26.**

*Proprietors:*

THE FOUNDRY PUBLISHING CO., Ltd.

**Devoted solely to the interest and advancement of the Iron, Steel, and Brass Trades of the United Kingdom.**

**PUBLISHED MONTHLY, ABOUT THE 18th.**

**SUBSCRIPTION TERMS:**
***7s. 6d. per annum, post free.***

**WE invite articles on all subjects pertaining to the trade in all its branches, which will be paid for.** MSS. should be written on one side of the paper only. Unaccepted MSS. cannot be returned unless accompanied by a stamped addressed wrapper. The correct name and address of writer should be written at back of MS.

*All communications for the Editorial Department to be addressed to the Editor.*

*Other communications to the Publisher of*
THE FOUNDRY TRADE JOURNAL,
104, Great Russell Street,
London, W.C.

Cheques to be made payable to THE FOUNDRY PUBLISHING CO., LTD., and crossed LONDON, CITY, AND MIDLAND BANK.

*All communications respecting Advertisements to be addressed to*
THE MANAGER,
ADVERTISEMENT DEPARTMENT,
104, Great Russell Street,
London, W.C.

## FOUNDRYMEN'S CONVENTION.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

DEAR SIR,—I am pleased with the progress that is being made in the correspondence *re* Foundrymen's Convention, but think the time has now arrived that we should go a little farther than mere writing in your valuable journal, and would suggest that a meeting be held of those who have written *re* the above Convention, and form themselves into a committee, appoint a secretary *pro tem.*, and to draw up a circular setting forth ways and means of making known the desire to form an association, the aims and objects of such, which should be sent to Foundry managers, Foundry foremen, &c.

Also to draw up a circular inviting the co-operation of engineering firms operating brass, iron, and steel foundries.

And, if convenient, would suggest that this meeting be held at the office of THE FOUNDRY TRADE JOURNAL or another convenient place to be agreed upon.

If any good is to result, and the association formed, this meeting should be held at once, for if the first meeting of the Convention is to be held this year at Manchester, we have no time to lose, especially if we desire to crown our efforts with success.

There will be a good deal of preliminary work to be done, and the sooner we get to work the better it will be for all concerned.

I enclose the name and address of a

Stevens 24 may 1925 - # 20, 28 - 51, 53 - 156, 158 - 159, 161 - 167, 169 - 210, 213 - 220, 222 - 228

Foundry manager who is willing to join, and hope to send you one or two more in the course of a few days. Thanking you for your assistance,—Yours sincerely,

WM. FINCH, Foundry Manager.

The name and address of one willing to become a member is Mr. F. J. Cook, 86, Milcote Road, Bearwood, Smethwick.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

DEAR SIR,—As a Scotchman I resent the insinuations of your "Scotch Correspondent" in the December issue, and that of "Mr. Wm. Finch" in your last issue (January), characterising us as "clannish." However, I am charitable enough to believe that both have used the term without seriously considering its meaning to Scotchmen; for, after all, who can tell whether the propagandist "Foundry Manager," who was the first to vent this question, be an English, Irish, Welsh, or Scotchman; and to the writer it is immaterial. I am sorry for having thus to draw your attention to those gentlemen's unguarded utterances, and hope that my writing you on this matter will in no way retard progress, but that all nationalities will work with a will for the good of Convention. And if held in Manchester would, in my opinion, serve a double purpose: first, the advancement of Foundry practice, and second, shall we say, in the words of Burns, assist to bring about the glorious time, "When man to man the warl' o'er, Shall brithers be for a' that."—Faithfully yours, "CANNY SCOT."

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

DEAR SIR,—I was pleased to see Mr. Longmuir's letter in your December issue, calling attention to the many subjects that could be taken in hand by the proposed Conventions.

To those of your readers who are familiar with the work of the American Conventions and Associations, there can be no question as to the beneficial results to all interested in Foundry work; and those who are not may do worse than subscribe to *The Foundry U.S.A.* to learn what their possible competitors are doing for the improvement of their work.

One object of the Convention should be to bring about a different method of buying pig-iron, viz., to specification within certain margins as advocated by the American society.

I think, Mr. Editor, you could give this subject a start at once by asking your readers to supply for publication, analysis and name of make of iron used in the various districts.

The published analysis of most makes are now out-of-date, and there may be others like myself who would prefer to pay extra carriage to get an iron suitable for their work, rather than accept what the local furnaces or merchants have to offer.

Please add my name to the Convention list, which I hope is rapidly filling.—Yours truly, F. JACKSON.

# Correspondence.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

DEAR SIR,—Before proceeding to make a rejoinder to "Mr. W. R.'s" somewhat caustic reply to my letter, I would ask him to kindly peruse the article from my pen in the present number.

"W. R." speaks rather disparagingly of my articles, as being "in tone hydrostatics pure and simple for the classroom, and, in consequence, meaningless in their relation to fluid pressure in the Foundry." Might I again make an "evasive reply," and say that "fluid pressure is exactly the same whether in the classroom or in the Foundry"; even "W. R." is dependent upon theory—the child of the classroom—for proof in his own arguments.

If to state that those who read "to get something to fit into their way of thinking read out of pride of heart only" is "twaddle," then I am indebted to "W. R." for pointing out the fact. Personally, I read for information; not to have my own opinions confirmed—at least, not always.

"W. R.'s" second paragraph deals with *my* "bulk for bulk" theory, and challenges me to disprove the facts and figures given in *his* articles on pages 162-3. If the "facts" given in my present article *are* facts, this is now done. Can "W. R." prove that the "facts" are fallacies? If so, I shall be pleased to learn wherein I have gone wrong, and until this is done, it is little use my going into his figures on paper.

In paragraph three, "W. R." says: "We have an exhibition of self-imposed blindness by a man who, to use his own words, 'has difficulty in explaining himself,' and is certainly paradoxical in the extreme." And all this simply because I stated paradoxically that *pressure is not pressure until it becomes* resisted.

To further explain this paradox. A mould is being filled, the metal falls down the runner, flows through the gates, enters the moulds, commences rising. Up to this time no force (except a negligible amount, due to friction of metal upon surfaces of the mould) is being exerted, and *not until the metal encounters on its rise a part of the mould or cores contained therein is pressure felt.* The force of momentum then comes into play, and *immediately* the metal rises above the surface encountered, be it mould or core. Then, and not till then, have we a "head" pressure, no matter the height of the runner. *Neglecting* the effect of *momentum* of the falling metal, the "head" on any particular surface can only be reckoned at any time (until the mould is full) from the top of the *lowest* metal surface, *e.g.*, if the metal has risen 6 inches above the base of a suspended core (green or dry), then the "head" on that core is only 6 inches, even though the runner be 30 inches deep.

Further on "Mr. W. R." asks "where the dividing line between cope and chaplet pressure comes in." The dividing line is here. "Cope" pressure is due to the "head," "chaplet" pressure to buoyancy, when chaplets are used to prevent a hanging or projecting core from *rising*. But the "chaplet" pressure must be added to the "cope" pressure to arrive at the *total* amount of weighting requisite.

Those who read "Mr. W. R.'s" last two paragraphs (the one preceding them I have answered either here or in my article) would be well-advised to re-read the paragraph (of mine) referred to. I do not, and *never did*, "maintain that gas and metal can occupy the same space at one and the same time." When I recommend that risers should be "stopped up," I do not infer that they should remain "stopped up," but only until the metal has reached the surface of the cope. While the metal is busy compressing the gases and forcing them through the natural or artificial vents it cannot rise as rapidly as it would do were risers left open, and hence, as I have said before, the final impact is considerably reduced.

If, likewise, "Mr. W. R." had allowed his fermentations of apparent anger against contradiction to pass away through their natural vents, and not obtrude themselves into his letter, the final impact on my carefully thought out statements would, I am sure, have been less severe.

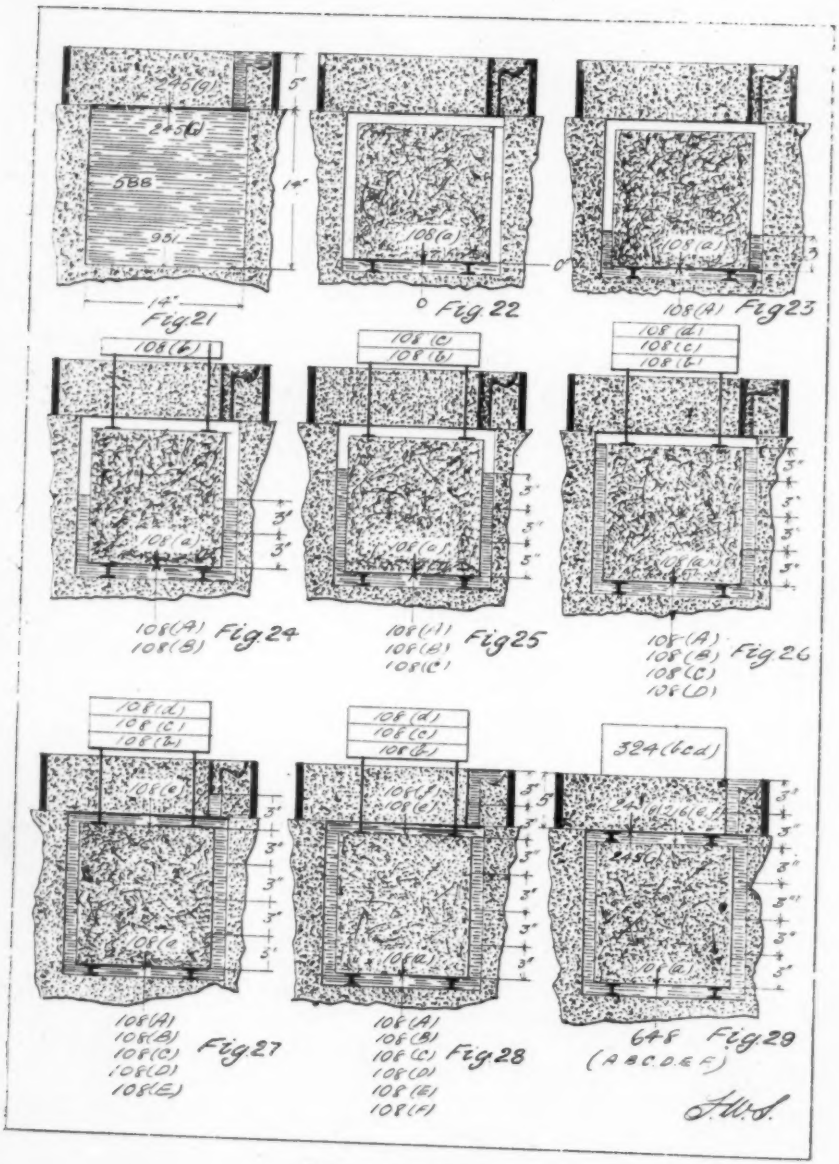
FRANCIS W. SHAW.

P.S.—I am indebted to "W. R." for the use of his "$\frac{1}{4}$lb. per c. in.," and agree with him that, under the circumstances, it is "near enough" for all practical purposes.

## PRESSURE IN MOULDS.—BUOYANCY OF CORES.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

DEAR SIR,—I HAD written "finis" to the series of articles on "Pressure in Moulds" which were published in the June, July, and August (1903) issues of THE FOUNDRY




PRESSURE IN MOULDS.

TRADE JOURNAL but statements which have been made in recent numbers lead me to reopen them with the view of clearing the air of certain erroneous views which appear to be current even among the "professors."

My teachings in the articles referred to on the buoyancy of cores have been seriously called to account.

I am aware that the theories therein advanced are not those generaliy in acceptance, some technical writers even—the "intensely practical" as a rule—having views of quite a distinctly different character.

However, I am convinced after carefully re-reading the arguments already given, that my theories are correct, and if so, they are capable of proof which cannot be impugned.

In order to make it possible for the untutored moulder to grasp the idea, and see the actual truth, I shall go through the subject step by step, in easy stages, *proving at each step, as far as principles go, the statements therein made, taking nothing whatever* that is germane to the subject *for granted, except the self-evident, and that which is generally admitted to be true.*

The means whereby I make myself clear, may to the "initate" appear peurile but a glance through recent issues of this journal will convince that the means are really necessary to secure the desired ends.

When the reader has read the argument to be presented, he may say, "Well! in theory you are right, but in practice——" To him I would say, theory is of two kinds the one based upon assumption, the other based upon fact. The theory that is based upon fact, can never conflict with fact, nor can it be "romanceful," in the slightest degree, otherwise we stand face to face with an absurdity, the *fact* that the false is true!

I must now ask the reader who has not already done so to refer to my previous articles, wherein was fully discussed and abundantly *proved*, the property which a fluid possesses of communicating any pressure which is imparted to it in every direction, to the whole of the mass, and to its surroundings, be the latter either the sides of a tank, or the walls of a mould, the intensity of such pressure upon any individual part of the mass or its surroundings being proportionate to the depth of such mass or surroundings below the source of pressure, considered as represented by a column of fluid, and the area of its surface.

In order to render this statement more intelligible, allow me to present it in illustration (see Fig. 21). This represents a mould 14 in. in height, length, and breadth—a 14 in. cube. The pressure upon the base, cope, and sides of the mould varies directly as the total depth of the mould to each surface, and the area of each surface. Taking the base, which is 14 in. square and 19 in. below the surface of the metal the total pressure upon it will be:

$\frac{1}{4}$ lb. $\times$ 14 $\times$ 14 $\times$ 19 = 931 lbs.

(a cubic inch of fluid metal is here considered to weigh $\frac{1}{4}$lb.)

The sides of the mould average a depth of 12 in. giving a total pressure on each side of:

$\frac{1}{4}$ lb. $\times$ 14 $\times$ 14 $\times$ 12 = 588 lbs.

The pressure upon the cope similarly is—

$\frac{1}{4}$lb. $\times$ 14 $\times$ 14 $\times$ 5=245lbs.

Hence the rule:—*To find the pressure upon any surface of a mould, multiply together the weight of a cubic inch of metal, the area in square inches of the surface, and the height of the metal above it.*

At this point I wish it to be clearly understood that *every mould or core surface in contact with the fluid is under pressure.* This of course follows from the statement that the pressure is communicated in *every* direction.

Coming now to the subject proper, the reader is referred to Fig. 22, a representation of the same mould with a 12 in. cubical core placed centrally therein. For convenience in dealing with the matter, the core is assumed to be made of

some refractory material, not subject to disintegration or decomposition by the action of heat, and weighing "bulk for bulk" exactly a quarter the weight of fluid metal. Whether or not this is the actual proportionate weight, matters nought in the consideration of bare principles. Also, throughout this article fluid metal will be assumed to weigh exactly ¼lb. per cubic inch.

In the mould, Fig. 22, the metal has just risen until it touches the under surface of the core. As the "head" of metal measures nothing, and the pressure is proportionate to the "head," it will be clear that the core receives no pressure from the metal.

But *immediately* the metal rises above the core, the "head," becoming a reality, pressure is at that moment imparted to the core, and when the metal has risen 3 in., giving a "head" of 3 in., the pressure upwards upon the core is:

¼ lb. × 144 (sq. in.) × 3 (in.)=108 lbs.

Now the weight of the core has been assumed to be equal to one quarter the weight of metal, one cubic foot of which weighs:

¼ lb. × 12 (in.) × 12 (in.) × 12 (in).= 432 lbs.

Hence the core in question will weigh:

432 lbs.÷ 4=108 lbs.

This is exactly equivalent to the pressure upwards upon the core, and consequently the core in Fig. 3 is just balanced, and no matter what additional metal is poured into the mould, the core would rise to keep the head a constant 3 in. unless prevented from doing so by the addition of weights as shown in the figures following Fig. 3.

In Fig. 24 the "head" has increased by 3 in., which results in an additional upward pressure of 108 lbs. (*B*), and to prevent the core rising, 108 lbs. (*b*) must be applied as shown to the chaplets. Thus is the pressure, twice 108 lbs., or *216 lbs.*, counterbalanced by the core, 108 lbs. plus the weight 108 lbs. (*b*), or *216 lbs.*

Again (Fig. 25) the "head" is increased by 3 in., and again the pressure added must be counterbalanced, 108 lbs. pressure (*C*) with a corresponding weight 108 lbs. (*c*).

And so we proceed—pressure augmenting by 108 lbs. at each step, and each time requiring an additional 108 lbs. weight to counterbalance it until the upper surface of the core is reached as seen in Fig. 26.

It will be noticed at this period in casting our mould, that the weights are three in number, and the core being on the point of submersion in the fluid metal buoyancy or the *tendency to float* is now, *just* overcome, for the core and weights are exactly balanced. Take only the smallest fraction from the weights and the core will rise until the "head" is reduced to match.

And now comes the reason for the insistence on the point of the universal communication of pressure.

Going one step further, in Fig. 27 we notice a further use of 3 in. in the "head," and yet only the same three weights (*b*, *c*, and *d*) in evidence. How is this? Simply this—and I think that no one can fail to grasp the point—although we have an additional *upward* pressure (E) of 108 lbs., we have a corresponding *downward* pressure from a 3 in. "head," upon the *upper* surface of core of 108 lbs. (*e*).

There is just as much reason to believe that the "head" applies pressure to the upper surface of the core, as to believe that the bottom of the mould receives pressure from the same source. Many cannot understand this, but if one accepts as a fact "universal communication of pressure," then he must also necessarily believe that the surface of the core is influenced by it, it being in contiguity to a mass of fluid metal.

Passing on we find that the pressure resulting from every addition to the "head" is received by both the upper and lower surfaces of the core (Fig. 28), the downward pressure counterbalancing the upward pressure. Hence there is no necessity whatever to increase the number

of weights. And this has been the case right from the moment at which buoyancy was overcome (Fig. 26).

In Fig. 29 the "through" chaplets have been replaced by studs. This alteration, however, cannot alter the amounts of pressure, as will shortly be seen.

Reverting to Fig. 21, the pressure upon the "cope" is seen to be 245 lbs. Let us assume that the "cope" weighs exactly 245 lbs., and this will exactly balance the pressure.

Returning to Fig. 29. We have seen that the weight necessary to overcome buoyancy is three times 108 lbs., or a total of 324 lbs. It is clear that this pressure will now be imparted *vid* the chaplets to the "cope," and hence the "cope," already counterbalanced with respect to the 245 lbs. (*G*) pressure, must be weighted to receive without lifting this extra 324 lbs.

From the foregoing I believe it is now clear that the statement made in the course of my articles on "Pressure in Mould," to the effect that the greatest head we can reckon on is that which exists when the core becomes just submerged, is true, and if this is so, then the following rule holds good.

Rule for weighing free cores:—*Deduct the weight of the core from that of a similar bulk of metal*—the result gives the actual weight to be applied to *overcome buoyancy only*.

Readers must not forget that besides "buoyancy" there are other pressures to overcome, resulting from speed of pouring, &c. But these have been already handsomely treated in the course of the previous articles. F. W. Shaw.

## REPLY TO "FOUNDERS."

Your hard castings may be caused in a number of ways both chemical and physical. Judging from your letter, I presume that your hard castings are thin, that you only melt your own scrap along with your pig, that your pig is suitable for your class of work, that only occasionally are some of your castings hard, and that you have no analysis of your materials.

I will enumerate some of the common physical causes of hard castings in the hope that it may help "Founders" and other readers of this journal.

First, and the most frequent, is too heavy charging of coke and iron. In any furnace measuring up to 46 in. diameter at the tuyeres inside the brickwork, from which light work is cast, no charge (excepting your first which should be all pig), should exceed 10 cwt. of iron, pig and scrap included. The reason of this is to prevent you when part only of the charge is melted tapping all pig into some ladles and mostly scrap into others. You will understand how easily and frequently this is done when you consider that some furnacemen make each charge up of as much as 2 cwt. of coke, with 13 or 14 cwt. pig, and 6 or 8 cwt. scrap; if your charge of iron is 10 cwt. only in a furnace over 30 in. diameter, you get nearly a simultaneous melting of pig and scrap, and your metal properly mixed.

Stripping the sand from castings while they are hot, and casting iron into thin shapes in greensand moulds at too low a temperature, thus cooling the iron too suddenly, are frequent causes of hardness.

The coal with which we are supplied to light our furnaces is a common cause of hardness, the yellow streaks or spots (iron pyrites) which are plainly visible, giving up sulphur to the iron. Another cause, often overlooked, the so-called boiling of the iron in a ladle that has not been properly dried, or of which the daubing has been made too hard.

R. Mason, Birmingham.

## HARD IRON.

If "Founders" had given a few more particulars of their working conditions, the cause of their difficulty might have been located with more surety.

If a few occasional castings in a day's cast is the trouble, the cause is most likely to be a purely physical one, such as the emptying of the castings from the mould too soon. The time of cooling has of course a great influence on the hardness of the metal, especially so if a low silicon iron is being used, and is a simple point too often overlooked in the Foundry.

Another likely cause is the pouring with dull iron, the tendency of the carbon to separate to the graphitic state being restricted owing to the low temperature of the metal and the mould.

If the iron has been got dull from the cupola, then it is more likely to contain more sulphur, the iron having retained that which would have passed off into the slag with a higher temperature in the furnace and a slag of greater fluidity if the castings have been found hard throughout a whole cast, this is one of the most likely causes.

Another likely place to look for the seat of the trouble is in the charging. Are "Founders" quite sure that the scrap charged is regular in quantity and class. The charging of scrap is a most important point, especially so where more than one kind is used, and a little carelessness on the part of the furnace man may cause a lot of trouble of the kind "Founders" complain of.

"BRUM BAIRN."

## PORTRAITS OF PIONEERS.

### II.—JAMES BEAUMONT NEILSON.

JAMES BEAUMONT NEILSON, to whose genius and perseverance we are indebted for the immense saving of fuel by the introduction of the "hot-blast" for iron-smelting, was born on 22nd June, 1792, in Shettleston, which was then a quiet roadside village, but is now absorbed in the bustling city of Glasgow.

His father, who was a millwright, contrived to provide for young Neilson a good, sound education, and comparatively early in life he commenced work with his father, and when sixteen years of age he began his apprenticeship as a

JAMES BEAUMONT NEILSON.

mechanical engineer. While so employed he "improved" his evenings by practising mechanical drawing and studying mathematics and other subjects.

Such was the progress he made that when twenty-five years of age he applied for, and got, the position of foreman and superintendent in the new Glasgow Gasworks. His services were well appreciated, and in less than five years he was appointed manager and engineer of the works.

Ever earnest, he continued his evening studies, and joined the evening classes at the "Andersonian"—the first Technical College in the world, at which those engaged at work during the day were provided with scientific instruction. Amongst his improvements in connection with gas manufacture may be noted the introduction of fire-clay retorts, the use of a new puri-

fier, and the invention of the swallow-tail burner.

To the Philosophical Society of Glasgow he, in 1825, read a paper, from which we find that he was in the way of working out that problem which brought him fame and well-deserved wealth. He experimented on the effects of hot air on a gas flame and on glowing fuel in a smith's hearth, and became persuaded that the theory which he had framed was right.

Briefly, he proposed to *heat* the blast of air *before* using it to urge combustion in the blast-furnace—an idea which the iron-masters received with good-humoured contempt. "What could a gas engineer know about blast furnaces?" It was ever thus. But by-and-bye Neilson entered into a co-partnery with three gentlemen connected with the Scotch iron trade to take out and maintain the patent rights. Experiments were entered on at the Clyde Iron Works in 1828. From the first his invention was a success, the output per furnace was increased, and the costs were reduced. Prior to its introduction the consumption of coal for the production of 1 ton of pig-iron was more than 8 tons; three years after, the consumption had dropped to slightly over 4 tons, and in the following year, as improvements were continued, 2 tons and 12 cwts. sufficed. To-day pig-iron is being regularly produced in the same district with a consumpt of 31 cwts. of coal.

True, we must not set down all the saving to the credit of the hot-blast, but it is fairly entitled to a large share. And when we remember that the world's production of hot-blast pig-iron is now over 40,000,000 tons per annum, we may gain some notion of the enormous saving of fuel and consequent lengthening of the life of our coal-fields, as a result of the thought and work of James Beaumont Neilson.

Now, when some iron-masters—Scotch, English, and Welsh—saw that the introduction of the hot-blast meant a substantial saving, they sought to utilise the idea without paying the modest royalty for which they could honestly have applied it. They pleaded insufficient description and want of novelty! Neilson and his partners had a long fight in the law courts. Litigation extended over five years. One trial lasted ten days, 120 witnesses were examined, and the expenses amounted to £40,000. During the trial it was admitted that one of the contesting firms had made a profit of more than £1000 per week. One witness swore that "cold-blast is most economical." Yet he, too, adopted the hot-blast! Jury and judge agreed in favour of Neilson's claims, and enabled him to reap a rich reward.

Success did not spoil Neilson—a sure sign that he was of a good stock. Remembering what he owed to the literary and technical tuition of his earlier days, he founded an institute to encourage the workmen under his charge.

In 1847 he retired from gas management after twenty-five years of faithful administration of affairs under his charge, and enjoyed the evenings of his life on the estate which he purchased. There, too, he carried on good work. He died in 1865.

His name is still honourably identified with his old college, and the Neilsons are amongst the best known iron-masters and engineers of their district.

WALTER MACFARLANE, F.I.C.

---

IRON CASTINGS, &c.—Iron castings, steel shovels, picks, &c., manhole covers, ventilator covers, lamphole covers, gullies, &c. Particulars from Jas. Lord, Borough Engineer, Town Hall, Halifax. Tenders to Keighley Walton, Town Clerk, Town Hall, Halifax.

# ALLOYS USED IN FOUNDRY PRACTICE.—II.

By PERCY LONGMUIR.

(ALL RIGHTS RESERVED.)

## BRASSES (*continued*).

HARD solders are occasionally made in the brass foundry; in composition these solders vary between the following limits:

Copper 60 to 34 per cent.
Zinc 40 to 66 per cent.

These solders are employed for brazing copper and brass articles, and their composition is arranged so as to yield a solder of a slightly lower melting point than that possessed by the articles to be brazed. As a rule the higher the content of zinc in the solder the lower the melting point, and conversely the greater the amount of copper the higher the melting point. Hence for copper articles a solder approaching 60 per cent. copper and 40 per cent. zinc is employed; whilst for yellow brass articles one of 34 per cent. copper and 66 per cent. zinc is usual. Brazing solders must be in a state of fine division; they are therefore granulated by pouring through a sieve into water, as a rule the divided stream of metal falling some distance before reaching the water. A fall of from 8 to 10 feet gives fairly uniform shot; such a drop may be readily secured in any brass foundry by removing one of the ashpit gratings, fixing an eighth inch mesh sieve in its place, allowing the molten solder to run through this sieve into a tank of water placed in the cellar. Brazing solders, or "spelters," as they are often termed, may be whitened by the addition of tin. One composition containing tin is given below:

Copper 50 per cent.
Zinc 38 „ „
Tin 12 „ „

*White Brasses.* — Brasses containing more than 60 per cent. zinc are too brittle for ordinary commercial castings; however, where brittleness is immaterial, these alloys high in zinc are to some extent used, finding an application chiefly in the casting of ornaments, statuettes, buttons, and so forth. These castings may be made in either sand or chill moulds; owing to the repetitive character this class of work the latter type of moulds are usually employed. As these highly zinciferous alloys are white or greyish white in colour they may, for convenience, be described as "white brasses." Certain of these alloys will admit of pressing—that is, after casting in a chill, the articles, such as fancy buttons and so forth, have their detail brought into sharper relief by means of steady pressure in a die. Three typical compositions of white brasses are as follows:

| | 1 | 2 | 3 |
|---|---|---|---|
| Copper | 20 per cent. | 43 per cent. | 34 per cent. |
| Zinc | 80 „ | 57 „ | 66 „ |

The composition of two of Sorel's white alloys are as follows:

| | 1 | 2 |
|---|---|---|
| Copper | 1 per cent. | 10 per cent. |
| Zinc | 98 „ | 80 „ |
| Iron | 1 „ | 10 „ |

White brasses, especially types approaching the two last varieties, readily admit of bronzing, and tints varying from green to chocolate, or dark brown, may be given by the various bronzing processes. For details of these methods the reader is referred to the series of articles on "The Coloration of Metals," which appeared in this journal. Castings of white brass subsequently bronzed are familiar in the form of ornaments, figures, and so forth; as a rule they are well finished, sold at a low price, and meet with a large sale.

In addition to the colour effect already indicated, increasing additions of zinc tend to lower the solidification points of the alloys. Robert Austen has examined a series of copper zinc alloys, commencing with pure copper, and gradually increasing

the content of zinc until an alloy containing 50 per cent. of each metal was reached. From this point copper in the successive alloys gradually decreases until metallic zinc is reached. In each case the freezing or solidification point of the alloy was determined, and the results published in the fourth "Alloys Research Report," issued by the Institution of Mechanical Engineers. The results embodied in the following table are extracted from this report.

THE SOLIDIFICATION TEMPERATURES OF VARIOUS COPPER ZINC ALLOYS.

| Copper °/o. | Zinc °/o. | Degrees Centigrade. | Degrees Fahrenheit. |
|---|---|---|---|
| 100·0 | 0·0 | 1082 | 1980 |
| 94·7 | 5·3 | 1076 | 1969 |
| 80·1 | 19·9 | 1008 | 1846 |
| 70·9 | 29·1 | 952 | 1746 |
| 59·7 | 40·3 | 886 | 1627 |
| 50·2 | 49·8 | 880 | 1616 |
| 41·2 | 58·8 | 840 | 1544 |
| 29·2 | 70·8 | 786 | 1447 |
| 20·0 | 80·0 | 705 | 1301 |
| 10·6 | 89·4 | 579 | 1074 |
| 0·0 | 100·0 | 419 | 786 |

Before passing on to the gun metals and German silvers, it may be well to give the composition of certain brasses not included in the foregoing article. For brevity's sake these compositions are tabulated as follows:

CLASS II.—GUN METALS OR MACHINE BRASSES.

Members of this class are distinguished from ordinary brasses in that tin is an essential constituent. The origin of the term "gun metal" is familiar to all Founders, and in not a few brass Foundries to-day certain types of moulding boxes are known as gun boxes owing to the fact that at one time they were used for moulding guns. Steels have, however, long superseded the use of copper alloys for ordnance, and the only guns now made in brass Foundries are purely ornamental ones, such as, for instance, the small cannon used to adorn the decks of a pleasure yacht. It is interesting to note that the composition used in English,

| Variety. | Copper %. | Zinc °/o. | Tin °/o. | Lead °/o | Iron °/o. | Other Constituents. |
|---|---|---|---|---|---|---|
| Aluminium brass ... ... | 63·0 | 34·0 | — | — | — | Aluminium 3°/o |
| Ditto ... ... | 60·0 | 39·0 | — | — | — | " 1°/o |
| British coinage ... ... | 95·0 | 1·0 | 4·0 | — | — | — |
| Bracelet antique ... ... | 83·0 | 16·0 | 1·0 | — | — | — |
| Chinese art bronze ... | 74·0 | 10·0 | 1·0 | 15·0 | — | — |
| Coin 42 B.C. ... ... | 79.2 | — | 8·0 | 12·8 | — | — |
| Celt, Irish ... ... ... | 90·7 | — | 7·5 | 1·3 | — | — |
| Delta metal ... ... | 55·0 | 43·0 | — | 0·4 | 1·0 | Phosphorus 1°/o |
| Egyptian chisel ... ... | 94·0 | — | 5·9 | — | 0·1 | — |
| Gilding brass ... ... | 82 0 | 16·0 | 2·0 | — | — | — |
| Ditto ... ... | 94·0 | 6·0 | — | — | — | — |
| Gold Mannheim ... ... | 80 to 88 | 20 to 12 | — | — | — | — |
| Gold mosaic ... ... | 65·0 | 35·0 | — | — | — | — |
| Gold Abyssinian ... ... | 94·0 | 6·0 | — | — | — | — |
| Ditto ... ... | 90·0 | 9·0 | — | — | — | Gold 1°/o |
| Japanese art bronze ... | 83·0 | 2·0 | 5·0 | 10·0 | — | — |
| Roman As ... ... ... | 69·7 | — | 7·16 | 21·9 | 0.47 | — |
| Pinchbeck ... ... ... | 84·0 | 16·0 | — | — | — | — |
| Ship nails ... ... ... | 53 0 | 42·0 | — | 5·0 | — | — |
| Statue of Napoleon ... | 75·0 | 20·0 | 3·0 | 2·0 | — | — |

German, French and American gun-founding was, approximately, copper 90 per cent., and tin 10 per cent. A type of alloy which has for ages found favour in many different applications from the razors and swords of the early Egyptians, the cannon and statuary of late mediæval times down to the modern steam fittings of to-day.

In addition to copper and tin, modern gun metals contain zinc in amounts varying from traces up to appreciable quantities. In the Foundry the addition of zinc to a copper tin alloy tends to produce a sounder casting. The Admiralty specification for gun metal steam fittings is copper 88 per cent., tin 10 per cent., and zinc 2 per cent. Not only is the composition specified, but test bars from the castings must show a tenacity of 14 tons per square inch, and an extension of 7 per cent. on 2 inches. Steam fittings must also successfully pass a working pressure test of 1,700 lbs. water.

This alloy, known generally as "Admiralty" or "Government" metal, is largely used for high pressure steam and hydraulic fittings, air and water pumps, engine and machine details, boiler mountings, and so forth. Owing to its high content of copper and tin, it is the most costly alloy of the gun-metal series, and in the foundry it requires careful treatment if the best results are desired. In making up these and succeeding alloys, the loss of zinc by oxidation referred to in the last article should be allowed for. Under ordinary conditions 25 per cent. of the 2 per cent. of zinc present will be lost.

The highest quality gun metals as used in high class engineering castings are shown in the following table:—

| | 1 | 2 | 3 |
|---|---|---|---|
| Copper | 88 per cent. | 86 per cent. | 87 per cent. |
| Tin | 10 „ | 10 „ | 8 „ |
| Zinc | 2 „ | 4 „ | 5 „ |

No. 1. is undoubtedly the best, but with care castings of No. 3 can be made to equal the results given by No. 1. For instance, the following mechanical tests have been obtained from the three alloys.

| | Tenacity in tons per sq. in. | Extension per cent. on 2 in. |
|---|---|---|
| Composition 1 | 18·0 | 11·0 |
| „ 2 | 17·0 | 10·5 |
| „ 3 | 16·5 | 9·0 |

The foregoing tests represent comparative conditions for the three alloys, under certain conditions the writer has obtained from composition No. 3 decidedly better results than from No. 1. The highest and lowest results obtained from some hundreds of experiments on composition No. 1. are shown below.

| | Tenacity in tons per sq. in. | Extension per cent. on 2 in. |
|---|---|---|
| Highest | 20·0 | 16·0 |
| Lowest | 6·5 | 3·7 |

In both cases the alloys were precisely the same composition, viz., copper 88 per cent., tin 10 per cent., zinc 2 per cent.*

| Composition. | | | Mechanical Properties. | | |
|---|---|---|---|---|---|
| Copper. | Tin. | Zinc. | Tenacity in tons per sq. in. | Extension % on 2 inches. | Reduction of Area %. |
| 85 | 13 | 2 | 11·9 | 1·5 | 1·4 |

Passing from the highest qualities to the general run of gun metals, the first effect towards a lessening of the cost lies in reducing the expensive metal tin to the lowest possible point. It may be well here to call attention to many of the erroneous compositions of gun metals given in various text books. For instance, a very familiar one is given as containing 16 per cent. tin. Instead of being a gun metal, such an alloy is in reality a bell metal, and almost capable of powdering under blows from a hammer. Quite apart from the prohibitive cost of such a composition, it would be far too brittle for engineering castings. In fact, bearing brasses, the chief essential of which is hardness, seldom contain more than 12 per cent. tin. To illustrate this the table on

*This variation of mechanical properties of alloys of identical composition will be fully treated in a later article.

the previous page gives tests of an alloy containing 13 per cent. tin which was made.

These tests represent the average of six results, and show at once the reduction of ductility due to the presence of even 13 per cent. tin. Only in the case of bearing brasses is it advisable to exceed 10 per cent. tin, such excess being accompanied by an increased hardness, a marked loss of ductility, and an enhanced cost of production. Typical types of ordinary gun metals are included in the following table :

| | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| Copper | 80 | 80 | 70 | 55 |
| Tin | 4 | 6 | 4 | 5 |
| Zinc | 10 | 8 | 4 | — |
| Lead | 6 | 6 | 4 | — |
| Merchant Scrap | — | — | 18 | 40 |

The first two are typical of ordinary gun metal, and are successfully used for valve bodies, engine and boiler fittings of the ordinary type, though not for fittings in conjunction with high pressure boilers, or high speed engines. Nos. 3 and 4 represent the cheaper types of gun metal in which outside scrap enters largely into the composition.

This scrap should be very carefully sorted into grades of as far as possible similar quality, and, in making up the charge, an equal portion of each grade used.

It is hardly possible to produce an alloy of constant uniformity when using merchant scrap, the character of which is essentially very varied, but within limits very successful castings may be made from compositions 3 and 4. This scrap may, if desired, be replaced by borings preferably melted down and cast into ingot form before use. Before melting down, these borings and turnings should be passed through a magnetic separator to free them from iron. Where the character of these borings is known they yield an alloy, after melting and casting into ingot form suitable for direct use without further additions.

Bearing brasses range in composition as follows :

| | | | |
|---|---|---|---|
| Copper | from | 88 | to 82. |
| Tin | ,, | 10 | to 14. |
| Zinc | ,, | 2 | to 4. |

An alloy of copper 84 per cent., tin 12 per cent., and zinc 4 per cent. is very suitable for solid bearings that have heavy work to stand, and for castings of this character this composition has met with much success. A fairly cheap and hard bearing metal may be made as follows :

| | |
|---|---|
| Copper | 52 per cent. |
| Tin | 8 ,, |
| Merchant Scrap | 40 ,, |

A common practice in brass foundries where hard alloys are occasionally required in small quantities is to make the casting of ordinary gun metal, stirring in the crucible a small quantity of tin just before pouring. Solid bearings were at one time exclusively made of a hard form of gun metal, these bearings are, however, now chiefly made of phosphor bronze. The majority of bearings at one time made from gun metal are now formed of a cast iron or steel bushes lined on the bearing surface with antifriction metal.

*Bell Metals.*—These alloys represent alloys containing the highest content of tin in the commercial series of copper tin alloys. Bell founding in ordinary practice is confined chiefly to ships' bells, works bells, such as starting and stopping bells, gongs, and so forth. Peals of bells usual to churches and public buildings form a speciality outside the range of ordinary practice, and do not warrant a

consideration here. The Admiralty requirements for ships' bells are five of copper to one of tin, or in percentages as follows:

Copper 83·3 per cent.
Tin 16·7 „

This alloy gives a good tone, casts well, and presents a good appearance when turned up. In practice this alloy is often made as follows:

Copper 82 per cent.
Tin 17 „
Yellow brass 1 „

The zinc of the yellow brass acting to some extent as a deoxidiser, thereby assisting in the production of sounder castings. Gong metal and two types of white bell metal are shown in the table below:

| | Gong metal. | White Bell metal 1. | White Bell metal 2. |
|---|---|---|---|
| Copper ... ... | 80 % | 18 % | — |
| Tin ... ... ... | 20 % | 80 | 88 |
| Bismuth ... ... | — | 2 | — |
| Antimony ... ... | — | — | 12 |

| | 1. | 2. |
|---|---|---|
| Copper ... ... ... | 72·7 | 52·4 |
| Zinc ... ... ... ... | 18·2 | 45·9 |
| Lead ... ... ... ... | 9·1 | — |
| Tin ... ... ... ... | — | 1·7 |

Ships' bells are occasionally made of much cheaper alloys than 82 per cent. copper and 17 per cent. tin as the two above analyses show.

Although compositions of this type are employed for the cheaper varieties of bells, their use is not to be advised, and the tone of the resulting bells cannot possibly compare with the high tin alloys.

Speculum metal is very rarely made in brass foundries of to-day, and the compositions below are only included as a matter of interest.

| | 1 | 2 |
|---|---|---|
| Copper | 67 | 68·21 |
| Tin | 33 | 31·79 per cent. |

The second one is known as Ross's alloy. These alloys are white in colour, exceedingly brittle, but they admit of a very high polish, and were at one time employed for mirrors, but for this purpose have long been replaced by glass.

### Class III.—Bronzes. Aluminium Bronze.

These bronzes consist essentially of copper and aluminium, the most general composition being that discovered by Dr. Percy, and containing

Copper 90 per cent.
Aluminium 10 „

In these proportions copper and aluminium form a definite chemical compound. Aluminium bronze has a higher contraction coefficient than gun metal, and castings of it require "easing" or moulds and cores so formed as to give readily when contraction commences. In order to obtain castings free from "drawn holes" fairly large gates are necessary, supplemented, if the casting is heavy, by risers on the heavier portions. Much cleaner castings are obtained by the use of "plug heads," and if the casting is large or intricate, the extra trouble involved in the preparation of this head is justified by the better appearance of the casting. This type of head is well known to founders:—briefly, it consists of a dry sand or loam reservoir with a plug fitted into the runner. The head is filled with metal, and the plug lifted, and a constant level of metal

being maintained in the head by the ladle until the mould is filled. By this precaution no oxides or dirt enter the mould, and extremely clean castings result.

Aluminium bronze in the cast condition has in the writer's hands yielded the following mechanical properties :—

| No. | Tenacity in tons per square inch. | Extension per cent. on 2 inch. |
|---|---|---|
| 1 | 16·2 | 6·2 |
| 2 | 21·2 | 12·2 |
| 3 | 22·4 | 2·0 |

No. 1 represents the test bar as cast; No. 2 a similar bar heated to a temperature of 745 deg. C., and cooled in air; and No. 3 represents a bar heated to 745 deg. C., and quenched in water. The mechanical properties of aluminium bronze in the forged condition are roughly double those obtained from the cast material. Aluminium brasses contain appreciable quantities of zinc with aluminium seldom exceeding 3 per cent. Two typical compositions of this variety of brass have already been given.

*Phosphor Bronze.*—In the case of aluminium bronze, the metal aluminium is always present in an appreciable amount, the remaining bronzes of this class are, however, noteworthy, in that the special constituent is present in small quantities only. Thus phosphor bronze is in reality an alloy of copper and tin containing traces of phosphorus. Two actual analyses of phosphor bronze are given below :

| | Phosphor bronze (ordinary) | Phosphor bronze (hard) |
|---|---|---|
| Copper | 89·31 | 88·63 |
| Tin | 10·16 | 10·32 |
| Arsenic | 0·01 | 0.01 |
| Antimony | 0·05 | 0.06 |
| Phosphorus | 0·47 | 0·98 |

The hard type of phosphor bronze is in foundry practice used for casting pinions, spur and bevel wheels, slide valves and bearing brasses. For high speed work a better bearing metal will be hard to find. The ordinary form is used extensively for low speed bearings and for various machine and engine details. Very heavy castings are occasionally made of this bronze, examples of which are found in the ram and stern fittings of a modern cruiser. The casting for the ram of such a cruiser weighs approximately 20 tons. The Admiralty requirements for bronze of this type are that it shall be made from one of the following compositions :

No. 1.

| | |
|---|---|
| Copper | 83 per cent. |
| Phosphor copper | 7 per cent. |
| Tin | 10 per cent. |

No. 2.

| | |
|---|---|
| Copper | 90 per cent. |
| Phosphor tin | 10 per cent. |

An average of four tests from the casting have to yield a tenacity of 17 tons per sq. in., an extension of 15 per cent. on 6 in., whilst a bar 1 in. diameter and 8 in. long must bend parallel over a 2 in. radius. A bronze made from either of the foregoing compositions will yield an analysis similar to that given as ordinary phosphor bronze. This analysis will also readily meet the foregoing specifications for mechanical properties provided that the usual care is exercised in melting the alloy and making the casting.

The phosphor copper employed contains approximately 15 per cent. phosphorus. whilst the phosphor tin contains about 5 per cent. phosphorus. The use of the latter alloy is recommended, and more reliable results appear to be obtained from the phosphor tin than are obtained from the phosphor copper. Pure phosphorus is not advisable in Foundry practice, its inflammable character when exposed to the air is well known; but apart from this difficulty there is a considerable loss when the stick phosphorous is added to the crucible of metal. This loss varies considerably and the writer has not yet been able to fix a standard to cover it. When stick phosphorous has of necessity to be used, a good plan is to cut it into small pieces whilst under water, take the pieces out and quickly dry with blotting paper and place them in a matchbox filled with dry parting sand, adding the box to the crucible as

speedily as possible. A better plan is to coat the stick phosphorus with a layer of copper which protects it from atmospheric action—in other words prevents it taking fire when exposed to the air. This is done by immersion for a time in a solution of copper sulphate, a thin layer of copper being deposited on the phosphorus. However, by far the best plan is to use either the phosphor copper or phosphor tin; these alloys may be readily purchased, and when using them comparatively, little trouble is experienced in obtaining the desired composition.

Turning to the mechanical properties of phosphor bronze, the following results were obtained from bronze of the mild or ordinary type, the analysis of which has been already given:

| No. | Tenacity in tons per sq. in. | Extension per cent. on 6 in. |
|---|---|---|
| 1. ..... | 19·0 ..... | 18·8 |
| 2. ..... | 20·7 ..... | 24·5 |
| 3. ..... | 21·5 ..... | 33·0 |
| 4. ..... | 22·4 ..... | 27·0 |
| 5. ..... | 26.2 ..... | 51·0 |

The foregoing results are typical of phosphor bronze castings, containing about 0.5 per cent. phosphorus. As the amount of phosphorous increases the ductility decreases, whilst the brittleness and hardness sharply increase. For a hard type of bronze 1 per cent. phosphorus is a suitable limit, but in cases where extreme hardness is required $1\frac{1}{2}$ or 2 per cent. may be added. Such an alloy would, however, be extremely brittle, and would be difficult to machine. A higher content of phosphorous than 2 per cent. is useless for castings.

In America phosphor bronzes lead is added in about the same proportion as tin. The analysis of such a bronze is as follows:

| | |
|---|---|
| Copper ..... | 19·7 |
| Tin ..... | 10·0 |
| Lead ..... ..... | 9·5 |
| Phosphorus ..... | 0·8 |

This is a type of bronze employed for car brasses, and is stated to possess good anti-frictional properties, in commoner varieties the content of lead is higher, and to some extent replaces tin.

A type of bronze closely akin to phosphor bronze is known as silicon bronze. Silicon, like phosphorus, acts as a deoxidiser, and by virtue of this, action tends to produce sound or oxygen free bronzes.

Silicon bronze has, up to the present, not attained a wide use in the foundry, its chief application being in the form of telegraph or telephone wire. The bronze is prepared by melting the copper and tin, and adding the requisite amount of silicon, in the form of a high ferro-silicon, or a cupro-silicon, preferably the latter.

The last, but by no means the least, important of the bronzes is that known as "manganese bronze," and in passing it may be noted that the metal manganese is not a prominent constituent of these bronzes. In foundry practice this alloy is chiefly used for solid propellers or propeller blades, and for this purpose no other alloy can compare with it. It resists corrosion remarkably well, and should the blades become in any way distorted, such as by fouling wreckage or the like, they can be straightened with little fear of cracking.

Manganese bronze is essentially a yellow metal containing traces of manganese and often fair amounts of iron. In many cases aluminium is present. The range of composition is indicated in the three following analyses:

| | 1 Per Cent. | 2 Per Cent. | 3 Per Cent. |
|---|---|---|---|
| Copper ..... | 60·0 | 60·0 | 53·0 |
| Zinc ..... | 38·0 | 38·0 | 42·0 |
| Manganese ... | 0·5 | 1·0 | 3·8 |
| Aluminium ... | — | — | 1·2 |
| Iron ..... | 1·5 | 1·0 | — |

In making up the alloy the manganese may be added either in the form of a cupro-manganese, containing about 20 per cent. metallic manganese, or in the form of ferro-manganese, the latter containing approximately 80 per cent. manganese. If

the ferro is used a certain amount of iron is necessarily introduced.

Average mechanical tests of cast manganese bronze are a tenacity of 24·5 tons per square inch and an extension on two inches of 22 per cent. Occasionally much higher values are obtained, and one method of obtaining high tests is to cast in an iron mould. The precaution advised in all alloys containing zinc must be adopted in the case of manganese bronze, and the loss of zinc by oxidation allowed for. Cleaner castings are also obtained by the use of the plug-head as recommended for aluminium bronze.

(*To be continued.*)

## PRACTICAL FOUNDING.

By W. R.

"Moulding Cylinders."

[All Rights Reserved.]

IT is generally admitted amongst moulders that no class of work gives more trouble and annoyance than the casting of cylinders, not only from the intricacies which often accompany the job, but the general nature of it. From the time it comes into the Foundry until cast and passed safely through the machinists' hands, and it may be hydraulically tested, no one can, with any surety, say that his work is good.

*Ramming.*—The natural beginning of this subject is the ramming of the job, after which will be considered other matters as they develop while working out the mould to the final stage of casting. The ramming of the job is of the utmost importance in securing a good casting, and the moulder who thoroughly understands how to ram his work has gained the mastery of one of the chief points which help to make an intelligent and successful moulder. Certainly there is not so much danger in ramming a dry-sand mould as there is in the ramming of a green-sand one, but still, too much hard ramming will not do for dry-sand, of which cylinder moulds are made. Therefore, the surest and safest rule to go by is to ram, as it were, a green-sand job.

*Venting.*—As regards the venting it is not absolutely necessary that this should be done, except there be projections, or, as they are commonly known to the moulder, "pockets," as the drying of the mould makes the sand so porous that the air passes quite freely from it without the aid of direct vents. Indeed, I have more faith in "sprigging" than venting in dry sand; but the use of sprigs is very often overdone, and there is no necessity for sprigging unless it be to protect the mould or some part that may have started with the "drawing" of the pattern.

*Finishing the Mould.*—This is a point on which I need say very little, as it is only by practice that anyone can be able to finish a mould successfully, hence I will give only one or two hints in passing. As soon as the pattern is "drawn"—and I hardly need say that the utmost care should be taken to secure a good draw—care should be taken to sleak down the joint, and to see that every part that may have started is put back into its proper place, so that, when it comes to the "closing" of the mould, every part may be fair and free from crushing. Some moulders seem to think that, because it is a dry-sand mould, any amount of water showered on it before finishing is beneficial; but such is not the case. No doubt, water is absolutely essential in making a strong mould; but if it is used indiscriminately, so as to cause the mould to be glazed, the consequence will be that the black-wash will not adhere to it, and, as a natural result, there is every likelihood that the skin will be covered with blisters in the drying; therefore, it is better to

avoid the free use of water; but, if it be desirable to strengthen any weak part, a little put on after it is finished will do good. Care should also be taken not to finish the mould, or polish it, until the grain of the sand becomes imperceptible, for to do so is lost labour, besides making it difficult for the black-wash to adhere to the sand. As it is not my intention to treat in detail every minor point relative to, or connected with, the making of the mould, believing that such would be of little value to the practical man and of little interest to the uninitiated, I consider it unnecessary to treat of the working of the black-wash further than to say that the drier the mould is before being black-washed the better; and, likewise, if it is allowed sufficient time to stiffen before being sleaked, it will materially assist in getting a good skin on the casting. The reason of this is obvious, from the fact that the drier the mould is it will take the black-wash the better, and, if this be adhered to, the results are sure to be satisfactory.

*Core-making.* — The core-maker should be careful to avoid ramming too hard, as any core so treated is difficult to vent, and likewise difficult for the dresser or fettler to clean from the casting. He must also pay particular attention to have a good clear vent, as this is the all-important factor in core-making, and must also be careful, before black-washing, to see that the surface of the core is entirely free from glaze, because there is nothing more dangerous in creating blisters, *e.g.*, if the core, or any part of it, be lying horizontally in the mould, such as in the case of the steam-chest, or part of the steam port. This blistering is of frequent occurrence in locomotive cylinders (if the above care be not taken), from the fact of there being more surface in the steam ports when cast on end. Of course, this trouble belongs to the top port entirely. There are many who hold the opinion that this fault is due to the chaplets. No doubt, a chaplet which is not clean, and is corroded with rust, will invariably have a bad effect; yet, after a careful, and more than casual study, of the subject, I believe by far the greater dangers arise from a hard and glazed core. The following is an example: I was once engaged making a class of cylinders, not necessary to name, which had a crown core, having from two to four feet of surface, and, as this core required no chaplets on its plain surface, it may, perhaps, astonish my readers to know that I was very much annoyed with blisters. Various things were suggested and tried without success. Ultimately, I tried "carding," or roughing of the surface, and it had the desired effect which put an end to the annoyance. From this it must be obvious that there are more causes attributable to creating blisters than chaplets, but chaplets that may not be clean should be burned, cleaned, oiled, or creosoted, and, if this be attended to, the most satisfactory results attainable will follow.

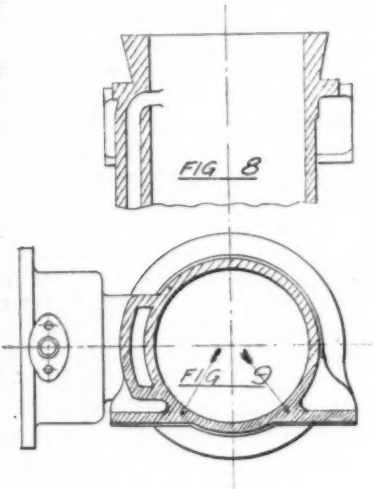
*Closing.* — Thus far the foregoing completes the moulding proper in a somewhat summarised manner, and we will now treat of the closing and casting of same, which, undoubtedly, is the most intricate part of the whole job. Indeed, it is no unusual thing to see in some Foundries men kept specially for the closing of moulds prepared by others; but, although this practice may facilitate the pushing forward of work, according to some people's ideas of economy, results, generally speaking, are more satisfactory when the man who moulds, closes, and sees to the final stage of casting his own job. Immediately on taking the mould from the stove or oven, the moulder's first duty is to see that it is thoroughly dried before proceeding with the "closing."

He should be satisfied that when casting it there will be no blowing from the damp which invariably gathers from moulds that are not properly dried. But, should there be urgent necessity to proceed with the casting, in the face of these adverse circumstances, the mould should remain open as long as possible, so that it may be comparatively cold before the top part, or cope, be put on for the last time. Because a mould with a great heat in it, and only half dried, when closed in this condition quickly generates steam, which condenses about the waste, or hemp, in the risers, and causes a great commotion by the metal bubbling and blowing as it fills in the riser basins at time of casting. It will be obvious that these remarks only apply to the smaller cylinders that are cored, closed, and cast in one day. Further, the greatest care should be exercised in securing the cores with the chaplets after the thicknesses have all been adjusted, which very often is the means of saving much time and trouble; for, to unfasten a core that has once been secured or jammed, frequently ends in some part of the core being displaced or broken; hence the necessity of having the thicknesses all properly adjusted before jamming. The next thing to be attended to is the securing of the vents, which cannot be too carefully done, as there is nothing more depressing to a moulder than to see his whole work going to destruction before him through lack of proper vents to allow the gases to get away freely from the cores, thus causing a bad casting, which might have been averted by the exercise of proper care. With cylinders that have the steam-chest, or casing, cast on them, it is necessary for the gas from the ports and exhaust to pass through the heart of the casing-core. The simplest manner of venting in this case is to daub the joints of the above with white, or any other suitable, loam; then clear the vents of the ports and exhaust, fill the heart of the casing with fine ashes, and conduct the entire vent through the joint of the boxes, or pass it up through the casing bearing in the top part, by the aid of a suitable tube or otherwise.

*Position of Casting.* — There is great diversity of opinion amongst engineers as to the position of casting cylinders, some inclining to cast them vertically or on end, others to cast them horizontally. The majority, I believe, favour the former plan, maintaining that, in the horizontal position, the dirt sticks about the barrel and creates a faulty bore. But, in the other cast of vertical casting, there is the common complaint of bad flanges on the top, or gate end, of the casting, which only comes to view when the sinking head is cut off. These imperfections are created during the process of solidification of the metal in the mould, which continues till the fluid metal is thoroughly set. These cavities are always greatest on cylinders that have a disproportionate thickness, as it is seldom, if ever, a plain barrel is thus affected. Now the best thing that can be done for this is to feed the casting as long as the metal is fluid; but, unless provision is made for the feeders, the feeding will be useless, consequently the sinking head must be made heavier, so that it may be the last part to solidify. (See Fig. 8.) The advantage of keeping the sinking head fluid until all the parts are set is apparent, as if it be thus kept fluid, and the casting fed, vacuum or shrink holes will, in a great measure, be minimised, if not entirely removed, in the case of cylinders that are cast on end.

Should disproportionate thickness of metal be confined to one side of a cylinder only, such as is the case with some locomotive cylinders, where the framing flange is on same side of the valve face, it is much better to confine

this extra thickness in the sinking head only, as it is about these parts that the mischief is wrought. Having thus formed a heavier sinking head, it




admits of heavier flow-gates being made, which gates should be made to a nearness as large as the thickness of the metal contained in the sinking head will admit. And, let it be remembered, that the only preventative against cavities is compression and feeding well. See to it that spongy parts, as at Fig. 9, with arrows pointed on same, be in immediate contact with the feeder, otherwise such parts will, undoubtedly, be faulty, or it may be a casting irretrievably lost.

And now as to the horizontal position, which has many commendable features about it, still, it is not without its troubles also, for, while in this position we get the most perfect valve-face possible, valve-rod paps uniformly solid, and the barrel-flange faces, which gives so much trouble to the vertically-cast cylinders (top end only are in this position entirely sound and perfect.

But it is with this position as it is with all others; no matter how we cast, the dirt is always to be found in some undesirable spot, so in this position of casting it is the extreme bottom part of barrel that all the trouble with dirt locates itself. Nevertheless, by the stratagem of gating, the horizontal and declivity positions have long been the fixed practice of casting in some of the best shops in the kingdom. Some gate one way and some another, and, of course, all are right; but there is one way of gating that we never saw a success, and yet it is the most natural way in general practice—namely, to gate off the joint. Now, to do this is, undoubtedly, bad practice, because of the fact that the dirt rushing in front of the metal along the barrel bottom gets hold to a greater or less degree on the extreme bottom of core, and, as the pressure increases with the filling of the mould, this dirt clings more tenaciously on the part referred to, and by its remaining there the hopes of securing a good casting are small indeed. This is a stumbling-block to many, as they maintain that all dirt, kish, or impurities, should find their way to the top of the mould.

We never saw a faulty bore on the extreme top side of casting, even although this part may not be all that could be desired, the bore invariably turns out perfectly clean, all impurities escaping to the higher extremities of the casting.

After a period of more than thirty years of moulding and casting cylinders for wind, water, steam, gas, and oil, and, taking these in their broadest application as they relate to the successful moulding and casting of same in the Foundry, I say, cast vertically, and feed well. Of course, in the casting of cylinders, as it is with almost everything else, we always find exceptions to the rule, and this is specially so with cylinders, jacketed, of all classes, the treatment of which would give more than material for another article.

## OCCASIONAL NOTES.

### Mechanical Testing.

A few notes on mechanical testing were given in the January issue of this journal, and in this month's notes it is proposed to deal with some of the results obtained from tensile and crushing tests. Fig. 1 reproduces six broken test pieces, showing an unbroken one in the centre. The table below gives the values obtained from these tests.

A comparison of these results, and the foregoing photograph, will prove instructive; for instance, the elongation and reduction of area at the point of fracture,

| Material. | Elastic limit in tons per sq. in. | Breaking load in tons per sq. in. | Elongation % on 2 inches. | Reduction of area %. |
|---|---|---|---|---|
| A Gun Metal ... ... ... ... ... | 8·5 | 14·9 | 14·5 | 16·7 |
| B Yellow brass ... ... ... ... | 4·0 | 12·7 | 43·0 | 35·6 |
| C Steel casting (hard) ... ... ... | 23·0 | 35·0 | 6·0 | 8·0 |
| D Steel forging ... ... ... ... | 25·2 | 39·8 | 26·0 | 48·0 |
| E Lead ... ... ... ... ... | — | 1·7 | 40·0 | 63·5 |
| F Cast-iron ... ... ... ... ... | 13·1 | 13·1 | nil. | nil. |

shown in the lead test piece and the forged steel, are very distinct from the straight sharp break of the cast-iron test piece. Similarly the yellow brass piece shows more "flow" under tensile stress than does the stiffer gun-metal one.

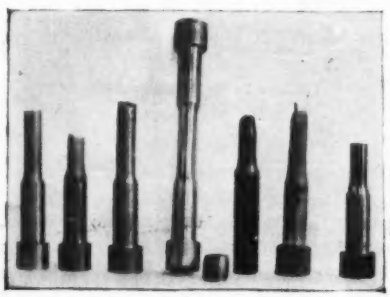


Fig. 1.

Fig. 2 reproduces a series of cast-iron crushing test pieces as they left the testing machine. The one marked A represents an untested piece. The values are as follows:—

| | No. | Crushing strength in tons per sq. in. |
|---|---|---|
| White cast-iron | 1 | 85 |
| | 2 | 75 |
| | 3 | 80 |
| Grey cast-iron | 4 | 50 |
| | 5 | 57 |
| | 6 | 54 |

The characteristic fractures of the white and grey irons will be noted; in the latter case the pieces have sheared into two parts, whilst in the former the pieces have broken into many fragments. With No. 2 the piece was so shattered that all the fragments of it could not be collected. G, Fig. 1, shows a steel crushing piece; the ductility of the metal is here shown, that, instead of fracturing, it has bulged from the shape, shown at A, Fig. 2, into its present form. The result is expressed in the following value:—

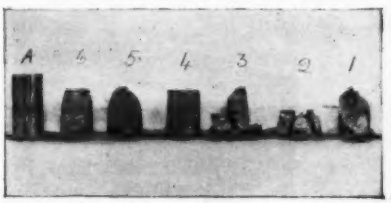



Fig. 2.

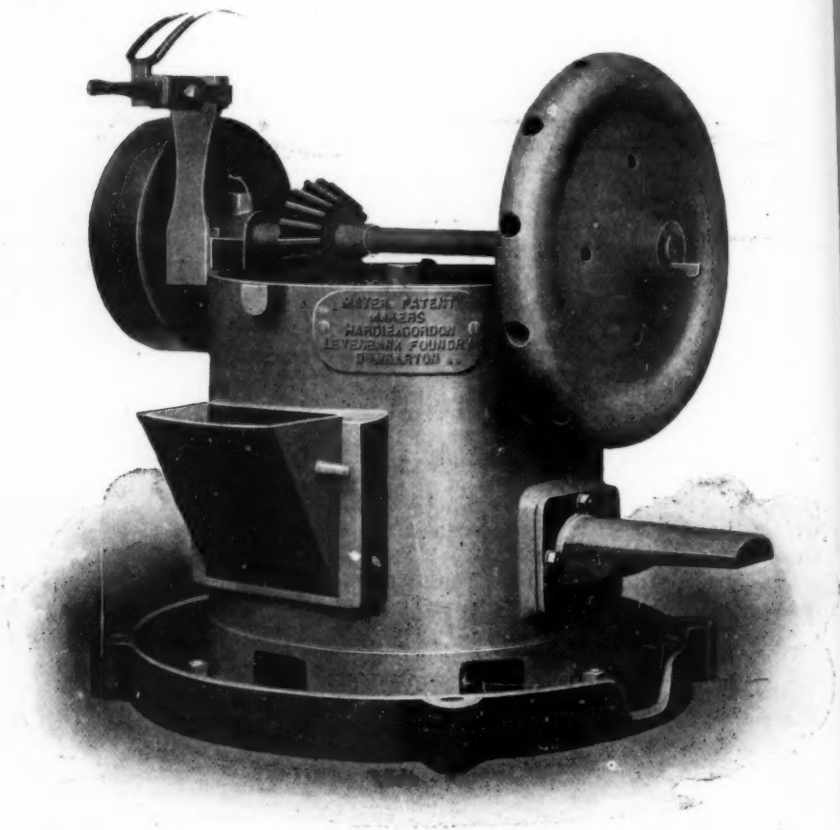
Compression % at 100 tons per sq. inch.

42·9.

Percy Longmuir.

## DESCRIPTION OF "MAYER'S" PATENT BRASS AND COKE RECOVERING MILL.

THIS mill works at about 150 revolutions per minute, and is driven by a belt working on a "fast and loose" pulley, which is fitted to one end of a cross-shaft, with a specially designed fly-wheel at the other. There are two bevel wheels working into each other—the one is keyed to the cross-shaft and the other to a vertical shaft, and drives the grinding and washing roller around a pan. The grinding roller works on a journal, secured by a special arrangement in the form of a grease-box, and at the opposite extremity of the journal there is an eye within which the flat arm on the vertical shaft is situated. A pin, which passes through the eye and the flat arm, secures them together and allows the roller freedom to rise when rotating in the pan, or when an extra large piece of slag or brass comes into contact. The pan and the base plate are cast in one piece, and has a loose, or false, bottom of soft cast-iron placed therein with a bevel to the centre of the pan, and to



suit this the grinding roller is made with a bevel, also is of soft cast-iron to prevent abrasion of the brass in the pan. The round body or tank of the mill is bolted to the base plate, and around the inside of the tank there is a projecting ring, cast on to the tank, a continuation of the same bevel as the pan, and which fits down on it, but leaves a very fine space, through which the grit or slag, ground down to fine sludge, is driven, and finds an exit out of the holes in the tank on to the flanged base plate. This flange extends all round the outside of the base plate, and forms a channel for the water and sludge, from whence it passes out into a sludge-tank by the side of the mill. The mill is fed with water, and the supply regulated with a tap. The charging-door has a diagonal web in its mouth to prevent the water from coming out. The path of the roller is, therefore, bevelled, and, always travelling uphill, takes the strain off the roller in the outward throw, and prevents undue wearing of the roller-bosses. There is also inside the pan a flat roller-wheel, with teeth made to work between the side and the centre boss of the pan. This wheel has a hole in the centre, into which a pin, a fixture to the flat arm of the vertical shaft, but works loose in the wheel, and, while the mill is in motion, keeps the material constantly stirred. The chief feature of the mill is that the grinding, washing, and stirring processes are performed simultaneously. The lighter material amongst the brass ashes, such as coke, slag without any brass, etc., etc., is thrown out at the spout. This spout has a cavity in it at the large end to catch any brass which has been forced to the outlet. In order to gather the brass in the pan, after it has been cleaned and properly washed, the water supply is cut off, and after the water which remains in the pan has been all forced out by the roller, the belt is shifted to the loose pulley, and the charging-door, with the diagonel web, is lifted out of its tapered-fitting seat, and a portable loose cast-iron scraper is then placed on the front side of the eye into a snug with a groove, and two turns round of the mill is made by means of the fly-wheel, whereby the brass is all left in a heap opposite to the charging-door. It is then either lifted out by hand or with a small shovel on to a cast-iron tray.

## THE MOTLEY MOULDER.

By a Foreman Moulder.

WHILE admitting to a very large extent the truth of the statement made by our friend, D. Loam, in his article upon "Bullying Foreman," and also admitting the necessity of a purer and higher standard for Foundry foremen, yet I would remind him that the fault is not always to be dropped down at the foreman's door.

Anyone who has come into personal contact with moulders in general knows perfectly well that they are not all saints. Our friend, D. Loam, writes of the debasing influence in the Foundry, and speaks of it as coming from the foreman. It has been said that moulders are of a "very low class." Well, I will not say that, but I will say that it is sometimes heartrending to witness the appalling inability of some moulders to fix their minds on the job in hand, to take hold and do the thing; their minds seem to be fixed on anything except moulding. Some moulders are dog fanciers, and they talk of their dogs all day long; others are betting men, and these are trying to make bets upon anything—horse-racing, footballing, cricketing, &c., &c.

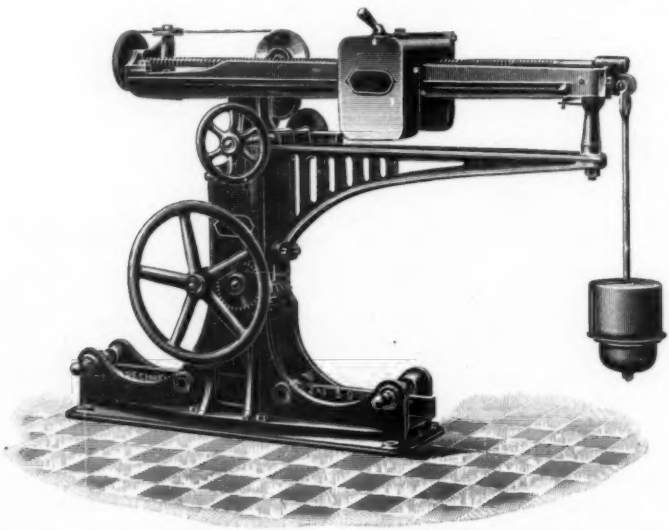
Look into the foundry any day, notice the moulder standing waiting for a lift. The labourer being away at the moment, think you that the other

moulders will trouble to give a lift, not they; they would see a brother moulder stand all day rather than lower their dignity to lift a box off.

Oh, that we had honest men in the Foundry, men who would cheerfully take hold and lift, men who would work as well when the foreman is away as they do when he is standing over them, men who would start work when it is time to, and not run round some corner just to finish their pipes! They sometimes require more energy than any bullying foreman is capable of to make them move at all. These men wonder when they are stood off; these men cry the loudest when other men are taken on in their places. Foremen are what moulders make them; let the moulders be honest; they will soon find the foreman will be honest with them; and let them do their duty to their employer, so that they shall not turn grey-headed before their time.

## A NEW TRANSVERSE TESTING MACHINE.

A new transverse testing machine for breaking cast-iron sample bars. This machine is arranged to break cast-iron specimen bars, 2 in. by 1 in., placed edge-way under bearings 3 ft. apart; also bars, 1 in. square, under bearings 1 ft. apart.



The superstructure of the machine is raised complete by a screw operated by the larger hand wheel, and so pulls up at the centre of the specimen, by a connecting rod. The steelyard, or indicating lever, is graduated by dividing engine up to 30 cwts., which is sufficient for ordinary mixtures of iron. A proportional weight, 10 cwts., is provided in addition, for extra strong metals. The travelling poise-weight is propelled along the steelyard by means of the screw shown, operated by the smaller wheel, and is not touched by the hand. The poise-weight cannot slip forward when the break takes place. The deflection of the specimen is accurately shown on an engraved index-plate. The machine is most accurate and easy to work. The sole makers are Samuel Denison & Son, Hunslet Foundry, Leeds.

# STEELS CONTAINING NICKEL.

(*Continued from page* 210.)

### Differences in Steels Containing Various Amounts of Nickel, Resulting from the Effects of Tempering and Hard Hammering.

It has been already shown that nickel steels behave very differently upon roasting and tampering according as they belong to one or other of the four groups introduced by the authors according to variations of mechanical properties. The steels of the first two groups are but very slightly sensitive to tempering, which has a great action upon those of the third group, though even more so upon those belonging to the fourth group. It has also been demonstrated that steels which have undergone completely the "irreversible transformation"—first and second groups—become very slightly hardened; that those the third group, which have but incompletely undergone the irreversible transformation, become appreciably so; and that those of the fourth group, which have not undergone it at all, become hardened to a remarkable degree.

The same distinction must be made in regard to the action of tempering and hard hammering upon the transformation points, to which such frequent reference has been made in previous contributions to this article. The steels of the first and second groups are but scarcely tempered and hard hammered; hence it is that these transformation points are somewhat removed from their first positions under the action of tempering and hard hammering. The steels of the third group, which have been but slightly subjected to the action of tempering and hard hammering from a mechanical point of view, are found to act similarly to those of the first and second groups; whilst with steels belonging to the fourth group, which are thoroughly tempered and hard hammered, the reverse is the result.

### Carburetted, Chrome, and Manganese Nickel Steels.

It may now be of interest to refer to the influence which is exerted upon the mechanical properties of nickel steels, according to the proportion of carbon, chrome, and manganese which they contain. Some very remarkable and interesting results have been obtained at Imphy, by way of mechanical experiments, with a nickel steel known as N.C. 4, the average chemical composition of which is as follows:

| | | |
|---|---|---|
| Nickel | ... ... | 20 to 25 |
| Carbon | ... ... | 0·6 to 0·8 |
| Manganese | ... | 0·5 (about) |
| Chrome | ... ... | 2 to 3 |

By its mechanical properties this steel resembles the so-called nickel steels which have not undergone the irreversible transformation, though it differs appreciably from them, inasmuch as the limit of its elasticity is much higher and its power of resistance to snapping far greater, as is likewise the extent to which it will stretch before breaking. It is in order to bring about an improvement in the quality of this steel that a good addition of chrome was made to it, at the same time considerably increasing the amount of carbon and manganese.

The first steel, known as N.C. 4, having been obtained after repeated experiments, the authors devoted themselves assiduously to ascertaining the part which each constitutive element played, as likewise the influence which varying proportions of carbon, manganese, and chrome had upon the physical and mechanical properties of nickel steels. Each of these three elements exerts a considerable influence over the conditions in which the so-called irreversible transformation is produced upon cooling — an influence which is even greater than that of the nickel itself.

The study of the so-called "nickel steels" has shown the preponderating influence of the position of the allotropical transformation point upon cooling, and has also drawn especial attention to the very great modifications which the physical and mechanical properties undergo when this transformation point drops below the ordinary temperature. A careful investigation of the physical and mechanical properties of N.C. 4 at once shows that it owes most of its special properties to the very low position of its irreversible transformation point upon cooling.

This nickel steel N.C. 4 is not magnetic, though the so-called nickel steels are all magnetic, and it thereby differs appreciably from these others. Its great stretching powers, as also numerous other special properties with which it is endowed, differentiate it from other nickel steels.

The authors of this interesting paper mention that, thanks to the intermediary of M. Guillaume, who sent samples of this steel, N.C. 4, to that eminent professor, Mr. Dewar, they were enabled to take advantage of the intense cold produced by liquid air. At a temperature of 188° C., magnetism did not appear, unless it be in a sample containing less carbon, chrome, or manganese than the others. This experiment enabled the authors to attribute the absence of the magnetism and the special mechanical properties of this steel to the very considerable lowering of the irreversible "transformation point" upon cooling.

The authors were, therefore, forced to the conclusion that carbon, manganese, and chrome have, like nickel, not only a direct action resulting from their special properties, but likewise an indirect action resulting from this influence upon the allotropical condition of the steel, this latter action being usually very preponderating.

It is not sufficient merely to point out the influence of carbon, manganese, and chrome acting simultaneously, but it is thought of sufficient interest to warrant a reference to the special action of each of these three elements. Account will, therefore, be taken successively of the authors' researches relative to the following three categories of steels, viz., carburetted nickel steels, chrome nickel steels, and manganese nickel steels.

(*To be continued.*)

## THE PASSIVE STATE OF IRON.

By Charles F. Burgess.

IN what may be considered the ancient literature of electrochemistry the fact was pointed out that iron and steel may be made to assume that peculiar condition known as the passive state by employing the material as an anode in suitable electrolytes. Among such solutions are sodium nitrate and various other soluble nitrates.

Upon assuming the passive condition, the iron no longer becomes attacked by the anode products, oxygen being liberated, and the metal acting toward the solution as would an anode of platinum. While this peculiar behaviour of iron, when used as an anode material, has been known for many years, it is only quite recently that it has been made use of in an industrial way.

An improvement in the method of brazing employed extensively in the manufacture of bicycles consists in dipping bodily a portion of the frame to be brazed into a bath of melted spelter, which is covered by a suitable *flux*. By this operation not only is the brazing effected within the joints, but a thin layer of brass adheres to the outer walls of the tubing, so that it becomes necessary to remove this layer in preparing the frames for receiving a coating of enamel.

An attempt was made to employ an electrolytic stripping process for removing this brass, but, upon trying a

great many electrolytes, it was found that the iron itself tended to corrode much more readily than did the copper which enters into the constitution of the brazing spelter; and the problem resolved itself into finding a solution which would dissolve the copper, but in which the iron would not corrode.

Iron has a position considerably above copper in the electrochemical series of elements, and where two different metals are in contact the natural tendency is for the more electro-positive one to go into solution with the greater ease. The idea presented itself of making the iron more electro-negative than the copper by causing it to assume the passive state, and upon using the sodium-nitrate solution in which this state could be developed it was found that the brass could be completely removed and the iron left intact.

This method of electrolytic stripping was installed and operated with success in various factories, and is now an important adjunct to the dip-brazing method. This same electrolytic stripping process may be applied equally well in removing silver, lead, tin, and other metals more electro-negative than iron from an iron surface. Nickel cannot be removed in this way, however, since nickel, as well as the iron, assumes the electro-negative or passive state.

In some correspondence with the Patent Office it was claimed that while the iron might assume a passive condition, becoming coated with a resistant film of iron oxide, it could not be considered as becoming electro-negative. For the purpose of determining this question, some measurements of single potentials were made upon iron before and after it had assumed its passive condition, and the results showed clearly the manner in which these metals behaved while being subjected to the action of the current. The measurements were made by means of a normal electrode of the "calomel" type, the potential of which was taken as —0.56 volt. The metal whose single potential was to be tested was placed in the electrolyte and the potential measured before applying an electrical pressure, and also after currents of different values had been caused to flow. It was found that up to a certain limit the single potential varied in accordance with the current density. These values at different current densities were determined by a specially constructed switch, which broke the current and immediately connected the electrode with the normal electrode circuit for an instant, long enough to determine the direction of the movement of the meniscus of a capillary electrometer used as a zero potentiometer instrument.

It was noted that the single potential of iron immersed in a sodium-nitrate solution before the current passed was in the neighbourhood of +0.2 volt. In other words, a potential was set up toward the solution in the same direction, but of less magnitude than would be produced by zinc. By causing the current to pass from the iron electrode, however, this potential quickly became negative, and increased rapidly in negative value until potential as high as —2 volts could be obtained under certain conditions. This potential of iron, when in the passive condition, is considerably higher than the single potential of platinum, and consequently in this condition may be considered as electro-negative to that metal. Its potential is approximately equal to that of the peroxide plate of the lead storage battery.

Copper, on the other hand, does not change its contact electro-motive force in anywhere near the same degree. The maximum electro-motive

force of copper was —0.65 volts, and iron may readily be made much more electro-negative than this value.

It was found that the iron did not assume the passive condition when used in sodium-nitrate solution freshly prepared, but that this condition was developed after the current had flowed for some time. This fact led to the conclusion that the solution underwent some chemical change which was favourable to the passive state.

In removing brass from iron, the current should remove it at the approximate rate of 1 gramme per ampere hour, provided that all of the current enters the solution from the brass and none of it utilises the iron as an anode surface. A brass and an iron anode, each having dimensions of 1 x 2.75 inches, were immersed in a sodium-nitrate solution to test the requirement. Each was connected through the ammeter to the same source of current. It was found that on first closing the circuit almost all of the current passed through the iron anode, but after operating for a few seconds the iron became passive, after which the brass took all of the current, the amount passing through ammeter being so small as to be hardly detected. By using very high current densities, however, the iron may begin to conduct a small portion of the current, thus causing liberation of oxygen on the iron surface. From these tests it was shown that the current has a high efficiency in the removal of the brass, and a practical trial has demonstrated that a small percentage only is wasted by flowing from the iron surface, provided the solution be maintained in good working condition

ORNAMENTAL SHELTERS.—Ten ornamental iron shelters. Particulars (£2 2s.) from and tenders to John S. Brodie, Borough Surveyor, Town Hall, Blackpool. March 2nd.

## GERMAN ENGINES FOR CANADA.

WITHIN the limits of the German Empire there are no fewer than thirteen works devoted to locomotive engineering, some of these having a capacity of no fewer than 300 engines per annum.

German locomotive builders are considerably favoured, in comparison with British builders, in the fact that the great majority of the railways are State-owned, and do not build their own locomotives, but simply repair them as occasion requires. All the railways are practically united under one system, with uniform standards, all this obviously working to the great advantage of the German locomotive builder, whose output is thus made up to a great extent of a large number of standard parts.

At the present moment the aggregate capacities of several of the works are more than equal to the German demand, and the result has been within recent times a seeking for foreign orders.

German-built engines have now, for the first time, entered Canada, twenty having been purchased by the Canadian Pacific Railway Company. These engines have six wheels coupled, each 5 ft. 3 in. in diameter, while the four wheels of the leading bogie have a diameter of 2 ft. 10 in. The cylinders are 22 in. by 26 in., and the steam pressure 210 lb. per square inch. The boiler, which is of large dimensions, is of the extended wagon top type, with radial stays to the firebox and a sloping front sheet.

The heating surface is as follows:—Firebox, 152.6 square feet; tubes, 2,262.9 square feet; total, 2,415.5 square feet. The grate area is 33.1 square feet. The boiler, inside firebox, and the tank plates are all constructed of the best mild steel, the

tubes are of weldless Swedish charcoal mild steel, while cast and nickel steel are largely used in the constructional details. The tender is of the hopper-tank type, and has a capacity of 5,000 gallons of water and no less than ten tons of coal. An electric lighting dynamo, placed just in front of the cab, and driven by a steam turbine engine, supplies current for an installation of incandescent lamps placed along the running boards, over the motion, in the cab, in addition to a powerful headlight. The engines are fitted with the Westinghouse-American combined air brake and a complete air signal equipment, as also the Gold system of steam heating.

Two new British-built engines arrived at Montreal some time ago, and both British and German built locomotives are now being submitted to trial running.

## QUERIES.

*This department of the* JOURNAL *undertakes the answering of queries in the following branches:* Blast Furnace Practice, Basic (steel making) Processes, Cast-iron, Malleable Cast-iron, Steel, Brass, Bronze, &c., *by eminent authorities in each branch. When necessary, the aid of chemical analyses, mechanical testings, micrographic, or microscopic examinations will be invoked.*

*The queries will appear repeatedly till answered. No charge is made to readers for answers, except where chemical, mechanical, or micrographic analyses are necessary, in which case the actual fee paid by us will be charged.*

*There are many other queries outside the scope above referred to which reach us at various times, which we trust our readers will afford us assistance in answering.*

*Communications should be addressed to the* "Editor, THE FOUNDRY TRADE JOURNAL, 104, Great Russell Street, London, W.C.," *and marked outside* "QUERIES," *and must be accompanied by the correct name and address of the querist, not for publication, but as a guarantee of good faith, which will be treated with strict confidence.*

I should like to ask you or any of your readers what you consider the best metal to cast fly or spur wheels weighing from 20 to 60 cwts. each (spur wheels cast blank to have teeth cut). I want the metal with the least possible shrinkage to prevent if possible any drawn place when the wheels are machined. MOULDER.

**Drying Moulds.**—Can any of your readers give us any information about drying moulds in the floor, preferably by producer gas, which we have available? GLOBE.

**Hard Metal in Castings.**—We are occasionally troubled with hard iron in our Foundry when using the same quality of coke and the same brands of pig-iron. We should be glad to know the probable cause and the remedy. FOUNDERS.

**Cast Steel.**—Can any of your readers recommend to me a good practical standard work on *cast steel* foundry practice? Any information as to the above will greatly oblige. BLACK SAND.

## ANSWER TO QUERY.

**"Spur Wheels Cast Blank that are to Have Teeth Cut."**—Much could be said on this question, but we must never lose sight of the fact that all metals cast into moulds, designed of various angles, junctions, and disproportionate parts, are, strictly speaking, non-homogeneous. But whatever variations in structure may be existent, this is the result of irregular shrinkage. Hence it is that any ordinary metal suitable for machine castings might also do for a spur wheel, assuming all other conditions to be equal. Of course, the life of a wheel must vary in proportion to its density and its uniformity of shrinkage, for no matter however good and strong a metal may be for casting wheels, if design and uniformity of shrinkage be not intelligently attended to, everything else must practically be a failure. Because, were moulders simply to make moulds

and cast them, and allow nature to do the rest, then the best metal procurable for casting wheels would, more than likely, give results inferior in the matter of shrink holes and cavities, than would follow that of a soft and unsuitable iron for wheels. Block wheels must at all times be troublesome, and the rougher the pitch the greater the danger of getting in amongst shrink holes, consequently the life of such a wheel is reduced when compared with the teeth that are cast by an ordinary spur wheel pattern. Those holes will always be greater in the immediate region of the arms, therefore the best that can be done is to place a riser on the rim right in line with the centre of each arm, and feed those parts well, and, if this be done with intelligence, one need have no fear of the result. A good mixture for work of this class would be three of medium machinery scrap to one of number one Scotch pig, or two of the same scrap, one of "Hematite," and one of "Scotch" number one, or any other brand, giving similar analysis, is exceedingly commendable. "FERRO."

[*For Replies to "Founders" see p. 45.*]

## AMONG THE FOUNDRIES.

**Day & Ockleford,** engineers, St. Leonard's Street, Bromley-by-Bow, have dissolved partnership.

**Bolckow, Vaughan & Co.'s** tender of £5 15*s.* per ton for 400 tons of steel tramway rails for the Cardiff Corporation has been recommended for acceptance.

**Mr. Frank E. Herbert,** iron and metal merchant, 146, West Regent Street, Glasgow, has assumed as partner Mr. Archibald Gilchrist. The name of the firm will henceforth be Herbert and Gilchrist.

**Bolckow, Vaughan & Co., Ltd.,** have secured the Bradford Corporation contract for 750 tons of girder steel rails at £5 13*s.* 11*d.* per ton, and steel fish-plates at £7 3*s.* 11*d.* per ton.

**J. & S. Roberts,** of West Bromwich, have secured the contract for the supply of 3,830 lineal yards of 6 in. pipes, together with the necessary syphons and irregulars, to the Glyncorrwg Urban District Council, at a cost of £791.

**Victor Cootes & Co.,** engineers, of Belfast, have completed a triple expansion three-cylinder stationary engine for the Corporation of Newcastle-on-Tyne. The total value of the engine and generator is £20,000, and the indicated horse power, 3,000 to 4,000.

**Davy Brothers, Ltd.**, Park Works, Sheffield, are reported to have in hand a huge metal mixer for the Ebbw Vale Works, to hold 750 tons of metal. The same firm are constructing a metal mixer to contain 200 tons for the Earl of Dudley's Round Oak Iron and Steel Works, Ltd.

**Messrs. Hall & Pickles,** of 64, Port Street, Manchester, announce that they have removed their iron and steel warehouse to new and extensive premises which they have built in the Trafford Park, closely adjoining the Manchester Ship Canal, where they have largely increased their stocks.

**The Barrow Steel Company, Messrs. Cammell, Laird & Co., Workington,** and the **Moss Bay Iron and Steel Company, Workington,** have just jointly booked an order for 30,000 tons of steel rails for the Guaranteed Indian State Railways, at prices varying from 95*s.* to 100*s.* per ton net, f.o.b. This is supplementary to the large Canadian rail orders already in hand. The Barrow Steel Company has booked the order for the plates, heavy castings, and other material required in the construction of the new Japanese warship to be built by Vickers, Sons & Maxim at Barrow.

IRONWORK, &c.—Ironwork, gun metal, and brass castings, ironmongery tools, &c. Particulars from E. A. Borg, Borough Surveyor, Town Hall, Margate. Tenders to Edward Brooke, Town Clerk, Town Hall, Margate. Tuesday, March 1st.

## SCOTTISH TRADE NOTES.

(By Our Own Correspondent.)

THE iron-foundry trade of the country continues exceedingly quiet. Very few firms can say they are fully employed, and in the Falkirk district many workmen, engaged in all the departments of the manufacture of light castings, are idle. The competition for the work which is going is exceedingly keen, and prices are not at all sufficiently remunerative. I had a talk the other day with an iron-founder who has been obliged to refuse several fairly large orders for rain-water goods because the prices offered would not cover the bare cost of manufacture and transit. The London market is still a fairly good oulet for Scottish light castings, and for cheapness these are for the most part sent by the Carron line of steamers. Were it not for the excellent facilities for transit which are offered by this line, Scottish founders would barely be able to successfully compete in the London market with the iron-founders of Luton and other centres in the near neighbourhood of the Metropolis.

**Much** interest continues to be taken by Scottish foundrymen in the proposed Foundrymen's Convention. The scheme which has been launched in your columns is being favourably received on this side of the border. It is surprising that such a suggestion has never before been mooted, not even in Scotland, where the iron foundry industry has been for a very long period such an extensive and rapidly growing one. In all probability there will be a number of representative Scottish foundrymen at the meeting to institute the convention, should it be held at Manchester during the July trades holidays. If it is felt that the arms of such a convention would be better fulfilled were there a separate organisation in Scotland there is no doubt that the ideas expressed at the suggested meeting in Manchester will be valuable in forming a Scottish Convention. It is not so much a matter of clannishness which will prevent Scotchmen joining their English brethren in the formation of a convention which would embrace in its membership the foundrymen of the three kingdoms; it is rather the inconvenience and the difficulty of visiting England for the length of time which would be necessary to attend and benefit by the members of the convention there.

**Many** Foundry managers and foundrymen generally will hear with regret of the death of Mr. George Binnie, formerly manager of Falkirk Iron Works, which took place at Falkirk a week or two ago. The deceased gentleman, who was eighty years of age, was born at Carron. In May, 1835, Mr. Binnie, when but a lad of eleven years, entered Falkirk Iron Works, where his father was foreman, and was apprenticed to the pattern-making. He early displayed an aptitude for his work, and this characteristic was developed as time went on. Messrs. Kennard, the proprietors of the Foundry, recognising the young man's conspicuous abilities, appointed him manager of the works in January, 1857, at which time he had completed twenty-two years in their employment. He remained in this important position, which he worthily filled, for the long period of thirty-nine years, and on several occasions he was presented with handsome testimonials, as tokens of esteem. He retired from the management of the works on March 31st, 1896, after completing sixty-one years' service with the Falkirk Iron Co. On his retirement the employees presented him with his portrait in oils.

**It** has been generally conceded that trade in the light castings industry has not for the last ten years experienced the depression felt during the past year. This, however, is hardly borne out by the report of Mr. Hugh Murdoch, the general secretary of the Central Iron Moulders' Association, of Scotland, which, with a membership of 4,000, has branches at Falkirk (4), Glasgow, Edinburgh,



745557A

Bonnybridge, and Bo'ness. The report, which deals with trade from March to December, states that in the Northern Division (which embraces Carron and Larbert) business was reported to have been bad from June, although for the three months preceding it was very much better. From the Central Division, comprising Abbots, Burnbank, Castlelaurie, Etna, Falkirk, and Gowanbank, it is reported that the Foundries were all engaged full time. In the Southern district, embracing Saltoun, Grahamston, Laurieston, Diamond, Callendar, and Parkhouse, practically full time was worked for the first three months. Latterly all the works, with the exception of Parkhouse (which is still working full time) were reduced to five days. Reference was made under our Cameleon column last week to the progress of trade. At Bonnybridge the five Foundries wrought the six days for the first three months, but there was a break from June, although during the last two months the works were fully occupied. The five Bo'ness Foundries have a good report. They have been employed full time throughout, with one exception, where the men were reduced to five days during the last two months of the year. The Edinburgh Foundries take their cue from those in the West.

**A very** interesting ceremony took place in the County Hotel, King Street, Aberdeen, recently, when Mr. George Swapp was presented with a handsome easy chair, with a suitable inscription, from his fellow-workers in the foundry department of Messrs. M'Kinnon & Co., Spring Garden Ironworks, to mark the occasion of his retirement from his trade as an iron-moulder. Mr. William Bruce presided and Mr. Buchanan, foreman moulder, in making the presentation, referred to Mr. Swapp in very eulogistic terms, and wished him good health in his retirement. Mr. Swapp, in returning thanks, made a very nteresting reply, touching on his long connection with the firm. After a few brief complimentary speeches, the company partook of a splendid tea, which was very much enjoyed. The rest of the afternoon was devoted to a musical entertainment. A vote of thanks to the chairman and to the committee—Messrs. Bruce, Airth, and Robertson—was heartily awarded.

**The** January report of the Associated Ironmoulders of Scotland states that the membership is 7,259, a decrease of 57. There are 5,316 men in employment, a falling off of 251. The income for the six weeks covered by the report was £3,361, while the outlay was £3,815, showing a loss to capital account of £454.

## MIDLAND NOTES.

THE Patent Axle Box Company, Ltd., are about to remove their Saltley business, Birmingham, to the picturesque village of Wednesfield. Here they have purchased at a moderate sum the extensive works that were some four years ago erected for the purpose of the manufacture of chocolate and other confections, but owing to the liquidation of Messrs. Pattison Gear, Ltd., the premises were put upon the market. The works are admirably situated for the carrying on a large ironfoundry industry such as the Patent Axle Box Company, Ltd., who are engaged in having a canal frontage on the south side some quarter of a mile long, while a loop line of the Midland Railway enters the works on the west side. The furnaces for the purpose of smelting of the iron required in the company's manufactures are being built on the most approved style, while the cupolas are to be of modern description. Hydraulics will be used for the lifting of the iron, coke and ores required in the smelting. It is expected that the improvements now going on will be completed by the end of the month or early in April. The firm employ nearly 400 pairs of hands, quite half belonging to the moulding trade. Wednesfield is an urban district within two miles of Wolverhampton, where large quantities of the best loam sand is extant.

**It** is pleasing to note that the Metallurgical class attached to the Boro' Science and Technical School, Wolverhampton, is increasing in membership. This is no doubt owing to the practical lessons that are being given. Various ironfounders in the Midlands have been approached, and at various intervals the students are allowed to visit the foundries and see for themselves the mode of manufacture. The Staffordshire Iron and Steel Works—the largest of its kind in the Midlands, and largely controlled by Sir Alfred Hickman, Bart., M.P., have been inspected by the members, and much useful knowledge obtained.

**Messrs. Joseph Evans, & Son,** of the Culwell Foundry, Heath Town, Wolverhampton, are extending their works. Just lately the firm have received some large orders for pumping machinery required in Australia and South Africa. Messrs. Evans, moulders, are now engaged in designing one of the largest pumps that was ever casted at these works, and full time employment is being made.

**The** piece workers employed at the Staffordshire Steel works, Bilston, have just had to suffer a decrease in prices. It is the custom hereabouts for the Company to employ heads or foremen who undertook to do the work at so much per ton, the contractors finding all the requisite labour. By this reduction, which was accepted by the contractors, one naturally infers that the system that has been in vogue since the establishment of the works is about to change, and that every man engaged will be placed upon the wages book at the head office, and will be under the direct control of the general managements.

**The** odd-side casters of Walsall are suffering through lack of work. Those who are habitually engaged in making small wares, such as are required for saddlery, are the worst off for trade. Since peace was proclaimed the saddlery trade has been a diminishing quantity, and seeing that this is one of the chief manufactures of Walsall, it tells seriously upon ironfounders thereabouts.

**Some** good orders for electrical work have been received at the Electric Construction Co., Ltd., Bushbury, and both the moulders and finishers are making full time.

**Employment** at the extensive works of Messrs. John Harper & Co., Ltd., Willenhall, is now rather short, and many of the employees are on short time.

## SHEFFIELD NOTES.

THE outlook generally throughout the whole of the iron and steel industries of this district cannot be said to show any signs of improvement with the opening of the new year. The state of business in almost every department (excepting those engaged in special lines), might be discribed as one of stagnation. In the heavy branches, especially those having to do with Government work, the condition is deplorable, these departments have been practically closed for months, and at the present time the outlook is anything but encouraging, as it is not anticipated that much of a start will be made before the end of the present quarter.

**Since** the advent of the new year, the departments engaged in the production of heavy castings and forgings for shipbuilding, etc., have been practically at a standstill. This is no doubt due to the lowness of freights, which is sure to have an effect upon the shipbuilding industry.

**The** different branches of the foundry trade remain abnormally quiet. Taking things all round, the output of castings cannot be said to be but little more than half the full capacity of these departments.

**In** the various sections of the engineering trades nothing in the way of improvements can be recorded, these departments continuing to remain in a very quiet condition. With regard to railway material, the home companies continue to give out

work very sparingly, and what is in hand is chiefly on foreign and Colonial accounts.

**High** speed tool steel, and specialities for tramways, etc., continue in good demand, some good orders having recently been booked for these classes of work.

**The** latest quotations for delivery in Sheffield are: Lincolnshire forge iron, 44*s.* 6*d.*; Lincolnshire foundry iron, 46*s.* per ton; Derbyshire forge iron, 45*s.* to 46*s.*; Derbyshire foundry iron 48*s.* to 49*s.*; East Coast hematites, 56*s.* to 57*s.*; West Coast hematites, 64*s.* to 65*s.*; bar iron, £6 10*s.*; Bessemer billets, £6 5*s.* to £6 10*s.*; Siemen Martin, £7 5*s.*; old rails, 62*s.* to 63*s.*; wrought iron scrap, 50*s.* to 52*s.*

**The** government have invited tenders in this district for the supply of 300,000 files of different size and make.

**It** is announced that an agreement has been effected for the combination of the firms of Messrs. William Jessop & Sons and Messrs. J. J. Saville & Co., of Sheffield, both firms have a high reputation for the quality of their respective products.

## NOTES.

**Last** month we imported 2,323 tons of rails, as compared with 4,696 tons during January, 1903.

**At** the present time the British Westinghouse Company employ 5,000 people at their works at Old Trafford, Manchester, where the buildings cover thirty acres of land.

**The** price of brass and copper tubes has been reduced ¼d. per lb., the basis figures now quoted for this class of material being as follows: Solid drawn brass and copper tubes, 7¼d. and 9¼d. per lb. respectively; brazed copper tube, 9d. per lb. Condenser plates are offered at a basis price of 6¼d. per lb.

**The** United Asbestos Company, Limited, of Dock House, Billiter Street, E.C., has, for the eighteenth year, been awarded by the Lords of the Admiralty the contract for the supply of asbestos goods for use in the Royal Navy. All the asbestos goods sold by the company, which is the only company in the world owning asbestos mines in Italy as well as Canada, are made at its mills at Harefield, near London, which have lately been extended to meet the increasing demand for its manufactures.

**A settlement** has been arrived at by the foundry and furnacemen employed by Messrs. James Oakes & Company, with regard to the proposed reduction of five per cent., commencing on 1st January. A number of meetings of the men have been held recently, and several deputations waited upon the manager, Mr. Bates, without satisfactory result, both masters and men indicating their firmness in the matter. The general secretary of the Union (Mr. Thorne) afterwards interviewed both manager and men, without any alteration in their decisions. Mr. Thorne advised the men to ballot on the question, and this was accordingly done at a meeting held at the New Inn, Riddings, resulting in the men accepting the masters' proposals.

## BIRMINGHAM AND MIDLAND IRON TRADE.

THE quarterly meeting negotiations resulted in the placing of a fair number of contracts for iron and steel. To some extent the reduction in the marked bar basis has facilitated business, merchants who had received shipping orders, including a proportion of high-class brands, having been able to distribute their contracts. There is a brisk demand for steel tubes for boiler, sanitary, and shipbuilding purposes, and best steel bars, sheets, and plates are in steady request for engineering, electrical, and rolling stock requirements. The representative of a leading steel firm states that he has secured more orders during the last eight days than for several months previously. It is

announced that a well-known Midland firm has decided to make its own steel billets instead of purchasing them from the Americans or Germans, and for this purpose has reconstructed its furnaces and laid down a modern steel-making plant. Last year the firm used 50,000 tons of German billets. Other firms in the district have also greatly improved and enlarged their steel-making appliances, though the production still only constitutes a small percentage of the total consumption. Marked bars are now selling at £8 basis, common bars realise £5 10s. to £6, and gas strip £6 upwards. Pig-iron has not appreciably altered in value as the result of the quarterly meeting business, but as stocks are low a spurt in demand will have a strengthening effect on quotations.

## ENGLAND *v.* AMERICA.

THE Underground Electric Railways' Co., of London, Ltd., have placed a contract for electric lifts for the whole of the "Yerkes" system of tube railways with the Otis Elevator Co., Ltd., of London. The works amount in value to about £350,000, this being the largest contract for passenger lifts which has ever been placed in this country or abroad. The lifts will be electrically operated from the Chelsea Generating Station, from which electric power will be furnished for the three railways comprising the system — namely, the Baker Street and Waterloo, the Charing Cross, Euston, and Hampstead, and the Great Northern, Piccadilly, and Brompton Railways. The underground stations will be fitted in most cases with four and, in some cases, with six lifts each, capable of raising

A LOAD OF 10,000 LBS.

equivalent to about 65 passengers, at a speed of 200 ft. per minute, the shafts varying from 40 ft. to 180 ft. in depth. The lift machinery will be of the well-known "Otis" type, and precautions will be taken to ensure the security of the public by the adoption of special safety appliances and of non-inflammable material throughout the mechanism and its accessories. Having regard to the fact that it was found necessary in the case of the Central London Railway to have recourse to American contractors to furnished the lift equipment for that line, it is gratifying to know that the advances which have since been made in lift engineering in Great Britain have led to the present large contract being placed with a British firm.

## A FEW REMARKS ON JOBBING SHOP MANAGEMENT.

IN commencing the management of a new Jobbing Foundry, there are some very difficult things to contend with. In the first place, you are not assured of a constant supply of work, which makes you have to exercise great caution in regard to the quantity of hands you set on, and also the quality of same, for you never know the class of work you will be called upon to perform; and you have to be prepared to take totally different jobs to what you had any idea of. And again, you are asked to quote for a firm's work. This is done; price accepted. Patterns come in. You then find that there are jobs which you know will tax you to the very utmost to make them pay. But they have to be taken along with the others. Some of these jobs the writer has found that, to make them simple, the amount of tackle to be made would cost considerably more than, perhaps, the value of the casting. Therefore, there only being one off, you endeavour to do without the tackle, and make the job in its complicated way. Bearing in mind that there is only one off, and if I can only bring it through

successfully this time, I must arrange, if the same job should come again, to have a price that will pay me to carry same through. Similar experience to this is only gained by those watching their work very carefully, and, if the price cannot be got for the individual article, let the same leave your shop, unless you have amongst the other jobs what you think is sufficient a margin to compensate. A little independency shown on the part of the Jobbing Founder in the refusal of work that he feels he is not sufficiently remunerated for, can only command the respect from those who are so refused. But Jobbing Founders have so striven against one another that the prices to be obtained for work has been so very small by the continual setting off one against another that the result has been, in a great many instances, their ruin.

But if an understanding could only be arranged amongst the Jobbing Founders in the various districts, and the true allegiance of one to another, they could so arrange that they could command prices that each and everyone could have a chance of making more than if they were not so associated. The benefit would be felt in so many ways. The firms who are in the habit of endeavouring to get the lowest price, by sending first for one and then the other, and telling them as they have had a lower quotation than theirs as each one goes, would have a great blow, such as such unscrupulous firms should have.

The object of such an association should be to have a good secretary, who could devote his time to the working of same, the secretary to be furnished with a list of firms each member is doing business with, to be kept privately from the observation of other moulders. The benefit that can be obtained by the above would be very considerable in this respect—that if a member was asked to quote by some firm, whom he had not done business with before, he could then see the secretary and ask him who were the members doing business for such a firm. The same is given him at once. He then goes to see his brother founder or founders, as the case may be, and, by telling them his errand, he becomes acquainted with all the facts that is needed to fit him for his object. I feel sure such information may result in the saving of various trouble, because it has been known that firms have transferred their business from those they have been doing with to others for financial reasons, the result being that more have been let in when failure has taken place than otherwise would have been if there could have been quick understanding got at amongst one another as above described. This, I maintain, is an assistance to jobbing shop management.

Again, I may indulge and say that a few remarks in respect of Foundry tackle for jobbing shops is one that is deserving of consideration. You cannot lay down any special plant, for you never can rely on the retention of any firm's work, but you have to use the best you can for the different jobs as they present themselves. I have worked for a firm of high-speed engine-makers, and there was a tremendous variation in their cylinder patterns. Anyone endeavouring to make, as it were, a box in a complete part would have found it very inconvenient and expensive, because it would mean to have such boxes for so many patterns, and, to endeavour to make such boxes come in, would almost destroy them by breaking some off here and there. But the style of boxes that I recommend is one made of loose sides, loose ends, and all bars loose. The bars can always be made to suit the various alterations that may be made in the pattern; the bars taken out can be saved for further

use. It is untold the usefulness of boxes of this description. It must be observed that all holes can be cast in the sides and ends, so that when taken out of the sand and roughly cleaned off and dressed they can be bolted together and ready for use in a very short time.

The sides of box require a flange all round, the ends being simply a flat plate, with holes cast in to bolt to the sides, also to cast a hole in for a swivel to be put in. The advantage of a loose swivel over a fast one is very great indeed.

A box like this can be joined up to another very close, where two boxes may be used for covering a job where, with swivel cast in, would mean a more complicated job. I always advocate a square hole for a swivel, and then cast on to a piece of square wrought-iron to fit the hole inswivel, the end of the wrought-iron to be screwed to take a nut; if kept well oiled they are no trouble to take out and put in at the different times. Care must be taken in making boxes of this description that provision is made for taking eye-bolts for turning up on end for casting in a vertical position. These eye-bolts are also better loose, for, when staples are cast in, they corrode very quickly and get very weak in a short time. The writer has used boxes of this description for such many varied jobs, that he feels, in his recommendation, a great pleasure. Patterns that are made in two halves, such as Miller Body's, in tool work, the writer has sometimes taken the end of two parts and bolted them together, forming one large box, and thereby been able to take one-half in the top part, thereby leaving a level joint. The advantage of this plan over the plan, if covered with a flat top, is easily seen. The one is easier rammed up, easier finished by not being so far down in the floor; in fact, in all cases where this plan can be adopted will always result in being more satisfactory, both to the moulder in it being easier to get at, and also to the proprietor in it being made quicker and better.

Again, in having to make fly-wheels from patterns supplied, the writer used to have some come in ranging from 5 ft. to 8 ft. diameter from full-bodied pattern, from 8 in. to 10 in. on the face, only of very light section. The iron-founder who had at one time these wheels used to grumble, because to make one or two of these without a blow all his gaggers were absorbed, which left the remainder of the shop without, and he considered he had plenty for his ordinary requirements when not engaged on these. My plan in making these was to bed them in the usual way in the floor, then ram the inside up, and then make the joint. I then had a grid made to fit between the arms, which gaggered in the spaces of the grid with short, straight gaggers; then rammed up to the level of the arms, then a layer of sand on the arms, then a layer of irons across the same and around the rim, you then can ram the same up to the top of the rim. You will observe the outside of wheel is not yet rammed up, thereby affording an opportunity of using the hammer around the rim for loosening it well, which is a decided advantage over having to do it all through the top part when all is rammed up, because the outside of wheel offers a great resistance. It must be particularly noted that these grids are made strong, three staples in each, and, to be particular, watch that a good skotch or support be in the centre of the grid, to be packed tight under the box-bar, so that when being screwed up it prevents you from screwing the grid from the faces, which, if done, the result is a fin between the arms, causing thereby a greater lifting strain to contend with, and if not reckoned with may result in

the same straining out all round. Then the advantage of grids against gaggering is discontinued. But I may also remind the reader that the grid plan is only half the time in making as the other, the casting far superior, owing to it being more regular. thereby it requires less finishing. The grid plan can be utilised in scores of instances, thereby giving greater security to moulds in the knocking about of them whilst green, and also the cost of gaggers, which very often deteriorate, where grids can be melted up and new ones made to suit requirements. Again, I may venture to suggest that there are so many patterns which come into a Jobbing Foundry for one off and two off that, if they were given in hand just as they come, the amount of boxes required would be considerable; and also to make them singly would result in costing a great amount for labour. The writer has a system whereby he puts a quantity in a box. The dissection of these taking place at various times out of patterns coming in, and laid at one side for particular boxes. The boxes that the writer has used run about 6 ft. long and 2 ft. broad, the bottom part 9 in. deep, with bars across the bottom; the top part is of light section, 5 in. deep, having six handles on, a straight one at each end, and a bow handle, 9 in. by 4 in. at each side in the middle. These are usually turned over good cotter-pins, and worked under a small jib crane. The castings made for me under this system has given me great satisfaction, both in quality and quantity. I may mention, also, that the patterns used in this way do not suffer the same knocking about as when bedded in the floor. In describing the above method I am not claiming to rob the bench of its work. But that is too large for bench, and, again, I claim that I have been able to manage with a class of men who, if they had to have bedded the same in, could not have given the satisfaction they have done under this system. This is, to a certain extent, saying that this class of men was not competent. I wish to point out that, to a certain extent, they were not. But if you have to have all full competent and experienced men, they do not care to stoop to have to make the various rough and plain jobs that you have to take in general shops, which requires practically no skill. Therefore, the different men you must keep to suit your requirements, for it must be understood that you could not expect men who are capable of taking jobs in hand of several tons in weight to be able to adapt themselves to take in hand small work and do it the same as those who are doing it regularly or *vice versâ*. The one works with more brain power than the other, hence my reason of trying to show the comparison of the various men you have to keep around you for your requirements, if you wish to get through your work and do it so as to come out right, so as to be able to make it out a profit. Of course, there are some who try to assist you in all they can, and others who are just the opposite. But, to get it out, the man in charge must be able to show them the way, and then he can get it as he wants it. Unless this is done you can depend on it that the jobs will not come out anything near the cost as they would do if supervised by one who knows. It requires a man of great experience to run a Jobbing Foundry, and a man who is not afraid of showing what he can do, and, at the same time, to be above criticism. The superior knowledge he has to show in the various ways to avoid this criticisms. A few are such in the materials he mixes and uses for the production of his work; another, the display of his idea in the making of jobs; another as to the weighting of jobs. What looks worse and causes such derision as to see a job left when

the word has been given that there is enough on by the person in charge. Again, when going to cast a job, a few tons in calculations are so accurate that he has as much again as what he wanted, which means if there is nothing else to cast as the spare metal will do for it has to be poured on the floor, to the disgust of almost everyone in the shop.

These are incidents I have seen occur more than once in shops that I have worked at as a journeyman. But, thanks to the more enlightened age we are now enjoying, when both lifting strain and calculation for quantity of metal can be got at in something like accuracy now, thereby saving labour in unnecessary lifting of weights, of unnecessary melting of more iron than is needed, which means a saving in so many commodities—viz., materials and time.

By an Old Moulder.

---

A fatal accident occurred at the foundry of Messrs. Hogg and Mason, Wandsworth Road, London, on January 25, 1904, whereby one man lost his life. A finished top part, weighing about two or three tons, was lowered on to trestles, when the moulder, H. Ellis, age 47, of 50, St. Andrew-street, Wandsworth-road, London, got under to see that it was all right, the trestles gave way, and the top fell upon him, crushing him so badly that he died of his injuries next day at St. Thomas' Hospital. Sympathy is felt on all sides for his widow and family.

## NEW INVENTIONS.

List specially compiled for The Foundry Trade Journal by Mr. GEORGE BARKER, Fellow of the Chartered Institute of Patent Agents, Consulting Engineer and Patent Expert, 77, Colmore Row, BIRMINGHAM, from whom all further information may be obtained regarding the Patenting of Inventions, the Registration of Designs and Trade Marks in England and abroad.
Telephone No. 1,300. Telegraphic Address—"Patent, Birmingham."

### APPLICATIONS MADE FOR PATENTS DURING JANUARY, 1904.

| | | |
|---|---|---|
| Improvements in sand moulding machines ... ... ... ... | T. R. Brown ... ... ... | 228 |
| Improvements in and connected with the manufacture of metallic alloys ... | J. B. de Alzugaray ... ... | 372 |
| Improvements in and connected with the making of iron and steel ... ... | J. B. de Alzugaray ... ... | 434 |
| A machine for holding or marking iron bars during the process of shortening and welding ... ... ... ... | O. Browne ... ... ... | 457 |
| Improvements in moulds and in the manufacture thereof, and in the moulding of articles thereby ... | J. F. Spencer ... ... ... | 615 |
| Improvements in and connected with the manufacture and refining of iron, steel, and other metals ... ... | J. B. de Alzugaray ... ... | 662 |
| Improvements in moulding or casting machines ... ... ... ... | W. Rone ... ... ... ... | 861 |
| Improvements in and connected with the making of iron and steel ... ... | J. B. de Alzugaray ... ... | 1,252 |
| Improvements in and connected with the manufacture of iron, steel, and their alloys ... ... ... ... ... | J. B. de Alzugaray ... ... | 1,551 |
| Improvements in processes for smelting and refining metals and in apparatus therefor ... ... ... ... | E. J. Richardson and G. James ... | 1,700 |

## METAL MARKET REPORT.

**Tin** opened on the 4th with a weak market at £134 5*s*., and fell off to £131 5*s*, on the 7th, again reaching £134 on the 11th. The market was very irregular throughout the month, and declined rapidly owing to heavy realisations, and the Banca sale on the 27th, closing on the 29th at £126 7*s*. 6*d*.

* * *

**Copper**, although in poor demand during the month, has maintained a fairly steady tone. The market received considerable support in the early part of the month from the firmness of the American market. Sellers on this side were reserved until weaker advices from America caused them to press sales towards the end of the month, and prices rated lower. Opening at £58 on the 4th, there was a rise to £58 17*s*. 6*d*. on the 11th, and from that date a decline to the end of the month with few irregularities to £56 5*s*. on the 29th.

* * *

**Spelter** opened dearer this January than last, and being in good demand the price rose from £21 15*s*. on the 4th to £22 2*s*. 6d. on the 29th.

* * *

**Lead** has been normal with slight variations between the 12th and the 28th, opening at £11 15*s*., and closing at £11 17*s*. 6*d*.

* * *

**Pig Iron.**—The pig iron market has been very dull, hematite and Scotch brands being practically dead letters; the only demand of any note being for Cleveland iron. The dealings in warrants are now of negligible quantity and have no effect upon makers' quotations, who manage to maintain steady prices.

**Hematite** opened at 54*s*. 6*d*., and closed at 54*s*. Scotch was normal at 49*s*. 9*d*. throughout the month. Cleveland opened at 42*s*. 9*d*., declining to 41*s*. 9*d*. by the 21st, but rallying from that date to the end of the month, it closed at 42*s*. 3½*d*.

## PRICES OF WHOLESALE COMMODITIES.

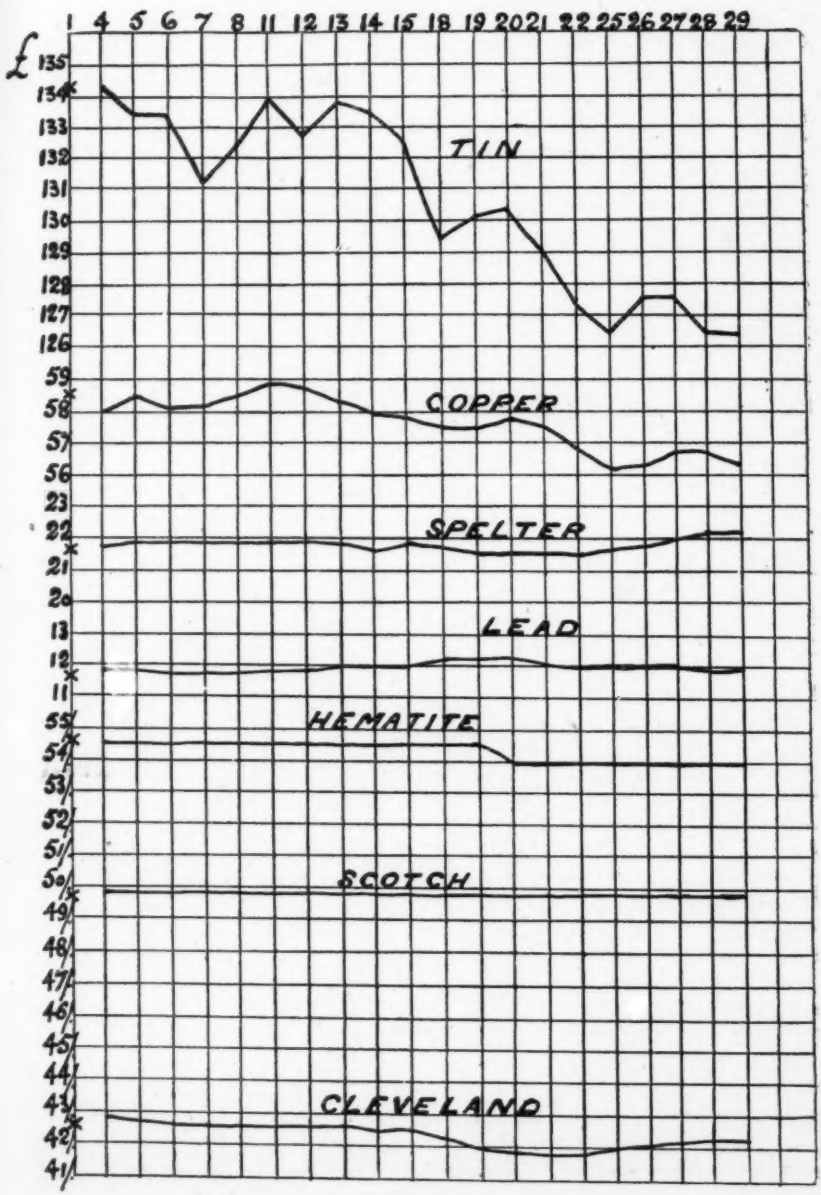
APPROXIMATE prices and position at latest date for which statistics are available, with prices and quantities at the corresponding dates in each of the last two years :—

| METALS. | 1904 | 1903 | 1902 |
|---|---|---|---|
| Iron—Scotch pig warrant ton | 50/1 | 53/0 | 49/8 |
| —Middlesbro' warrants ton | 42/6 | 47/1½ | 44/9 |
| —W.C. M/nos Bessemer ton | 54/0 | 59/6 | 58/6 |
| —Staffordshire bars, Lond. ... ton | £6 10—£8 10 | £7—£7 5 | £10—£10 5 |
| —Welsh bars, Wales... ton | £6—£6 5 | £6—£6 5 | £8—£8 5 |
| —Stock, Scotch, Feb. 5 tons | 9,070 | 21,861 | 55,620 |
| Copper—Chili bars, GMB ton | 55 15-55 16/3 | 56 8/9-56 10/0 | £55 2/6 |
| —Stock, Europe and afloat... tons | 14,233 | 15,131 | 23,312 |
| Tin—English ingots ... ton | £127-£127 10 | £131-£131 10 | £113-£113 10 |
| —Straits ton | £125 2/6-125 5 | 130 10-130 12/6 | £111—111 2/6 |
| —Stock, Ldn, Hind. and afloat... tons | 10,963 | 10,161 | 12,230 |
| Tin plates—Charcoal I.C..... box | 12/6—14/0 | 14/0—15/6 | 14/6—16/6 |
| Lead—English pig ton | 11 10—11 12/6 | 11 15—11 17/6 | £11 17/6-£12 |
| Spelter—Ord. Silesian ton | £21 15—£22 | £20 5—20 7/6 | £17 10-17 12/6 |
| Quicksilver—(75lb.) bottle | £8 5 | £8 12/6 | £8 15 |
| Antimony—Regulus ton | £26—£27 | £28—£28 10 | £29—£30 10 |
| Coal—Lyons Wallsend, London ton | 17/0 | 16/0 | 18/0 |

CAST-IRON SOCKET PIPES, &c.—Cast-iron socket pipes, in various sizes, with the usual fittings; sluice valves, in various sizes, with surface boxes; Metropolitan pattern hydrants, with boxes, stoptap boxes, wrought-iron tube and fittings (water quality), &c. Particulars from F. Stanley, Town Hall, Margate. Tenders to Edward Brooke, Town Clerk, Margate. Monday Feb. 29th.

WROUGHT-IRON GOODS, &c.—Wrought-iron goods, engine-room stores, and ironmongery for electricity department. Particulars from W. M. Rogerson, Borough Electrical Engineer, Foundry Street, Halifax. Tenders to Keighley Walton, Town Clerk, Town Hall, Halifax. Monday, Feb. 29th.

## CHART OF THE FLUCTUATIONS OF THE METAL MARKET IN JANUARY.



# CONTENTS.


| | PAGE |
|---|---|
| Foundrymen's Convention | 39 |
| Correspondence | 40 |
| Pressure in Moulds | 41 |
| Reply to Founders | 43 |
| Hard Iron | 45 |
| Portraits of Pioneers | 46 |
| Alloys used in Foundry Practice.—II. | 48 |
| Practical Founding | 55 |
| Occasional Notes | 59 |
| Description of Mayer's Patent Brass and Coke Recovering Mill | 60 |
| The Motley Moulder | 61 |
| A New Transverse Testing Machine | 62 |
| Steels Containing Nickel | 63 |
| The Passive State of Iron | 64 |
| German Engines for Canada | 66 |
| Queries | 67 |
| Among the Foundries | 68 |
| Scottish Notes | 69 |
| Midland Notes | 70 |
| Sheffield Notes | 71 |
| Notes, Birmingham and Midland Iron Trade | 72 |
| England v. America | 73 |
| A Few Remarks on Jobbing Shop Management | 73 |
| New Inventions | 77 |
| Metal Market Report | 78 |
| Metal Chart | 79 |



# SAND MIXER.

Money to be got but he can't see it.

**PATENT**

## Moulding = Sand Mixing Machine.

Does *more and better work in one hour* than can be done by *two men in ten hours* in the ordinary way.

**ADVANTAGES.**

1.—Requires very small driving power.—One H.P. for 2 tons per hour.
2.—It accomplishes a great amount of work in a very short time.
3.—Durable. Repairs are hardly ever necessary.
4.—The outlay is insignificant in proportion to the results, and is soon recovered by the enormous saving in wages and better castings.

Ironfounders or their Managers invited to see the Machine at Work.

**J. BAGSHAW & SONS, LTD., Batley, Yorks, Eng.**